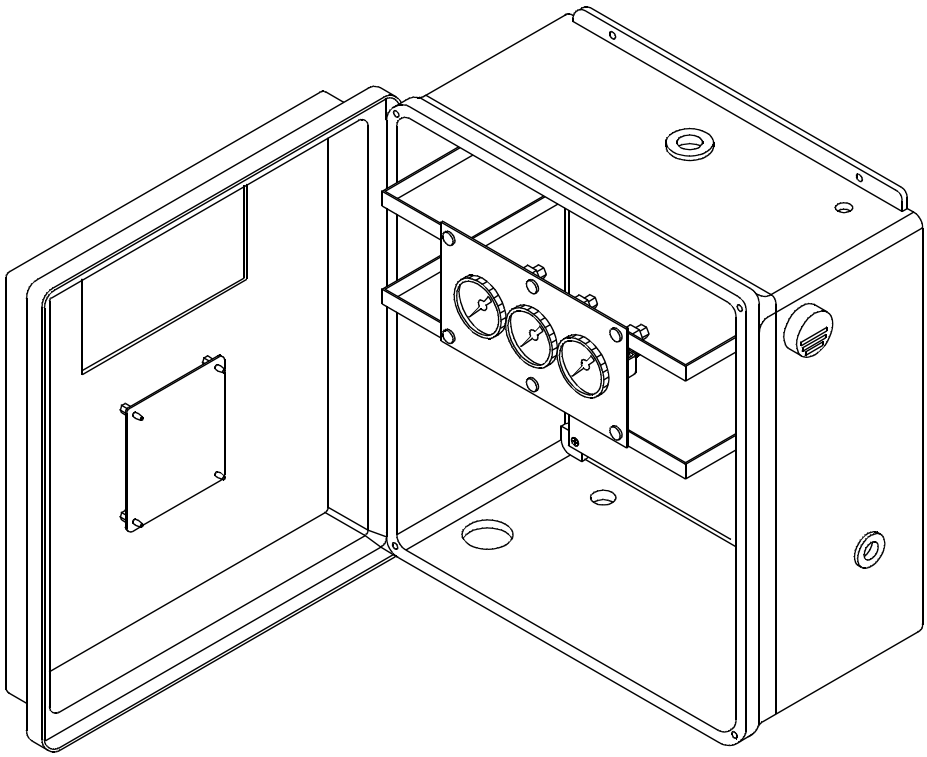
WESTERN INNOVATOR

AUTOMATIC CHANGEOVER MANIFOLD

HQ2, HQ2HL, & HQ2HP SERIES

SERVICE MANUAL



SAFETY
Statements in this manual preceded by the following safety signal words are of special significance. Definitions of the SAFETY signal words follow.

DANGER
Means a hazard that will cause death or serious injury if the warning is ignored.

WARNING
Means a hazard that could cause death or serious injury if the warning is ignored.

CAUTION
Means a hazard that may cause minor or moderate injury if the warning is ingored. It also

may mean a hazard that will only cause damage to property.

NOTE
Indicates points of particular interest for more efficient and convenient operation.

INTRODUCTION
This manual provides the information needed to service the Western Enterprises HQ2, HQ2HL, and HQ2HP series manifolds. This information is intended for use by technicians or personnel qualified to repair and service manifold equipment.

The information contained in this document, including performance specifications, is subjected to change without notice.

WARRANTY
Western Enterprises makes no warranty of any kind with regard to the material in this manual, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Refer to the **Installation and Operating Instructions** manual for warranty information.

CAUTION

- Failure to follow the following instructions can result in personal injury or property damage:
- Never permit oil, grease, or other combustible materials to come in contact with cylinders, manifold, and connections.Oil and grease may react and ignite while in contact with some gases — particularly oxygen and nitrous oxide.
- Cylinder, header, and master valves should always be opened very s-l-o-w-l-y. Heat of recompression may ignite combustible materials.
- Pigtails should never be kinked, twisted, or bent into a radius smaller than 5 inches. Mistreatment may cause the pigtail to burst.
- Do not apply heat. Some materials may react and ignite while in contact with some gases — particularly oxygen and nitrous oxide.
- Cylinders should always be secured with racks, chains, or straps. Unrestrained cylinders may fall over and damage or break off the cylinder valve which may propel the cylinder with great force.
- Oxygen manifolds and cylinders should be grounded. Static discharges and lighting may ignite materials in an oxygen atmosphere, creating a fire or explosive force.
- Welding should not be performed near nitrous oxide piping. Excessive heat may cause the gas to dissociate, creating an explosive force.

ABBREVIATIONS

C _____Common
CGA_____Compressed Gas Association
FT-LBS __Foot-Pounds
IN-LBS ___Inch-Pounds
N/C _____Normally Closed
N/O _____Normally Open
NPT _____National Pipe Taper
OSHA ___ Occupational Safety & Health Association
PSIG____ Pounds per Square Inch Gauge
SCFH ___ Standard Cubic Feet per Hour
VAC ____ Voltage, Alternating Current
VDC ____ Voltage, Direct Current
PCB ____ Printed Circuit Board

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INTRODUCTION & GENERAL INFORMATION

PRODUCT DESCRIPTION

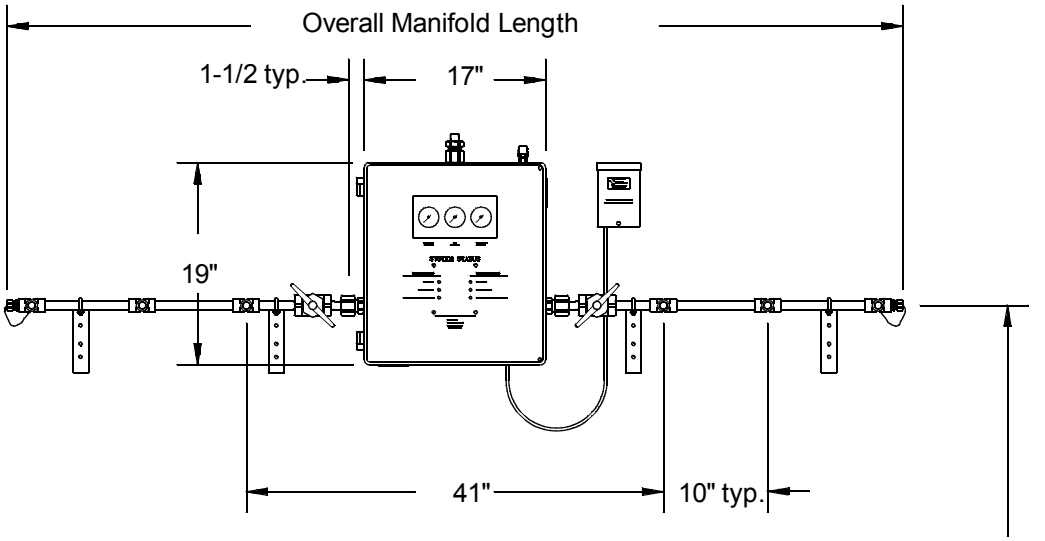
The automatic changeover manifold is designed to provide a reliable uninterrupted supply of gas to a hospital or clinic's medical gas pipeline system.

The manifold has an equal number of cylinders in its "Service" supply and "Reserve" supply banks, automatically switching to the "Reserve" supply when the "Service" supply becomes depleted. When the manifold changes to "Reserve" supply, it sends a signal to the hospital or clinic's medical gas alarm system alerting the personnel of the need for the exhausted bank of cylinders to be replaced with full cylinders. After new cylinders are in place and turned on, they are automatically placed in "Reserve". No manual resetting of the manifold is necessary.

INSTALLATION INFORMATION

Manifolds should be installed in accordance with guidelines stated by the National Fire Protection Association, the Compressed Gas Association, OSHA, and all applicable local codes. The carbon dioxide and nitrous oxide manifolds should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 20°F (-7°C). The manifolds for all the other gases should not be placed in a location where the temperature will exceed 120°F (49°C) or fall below 0°F (-18°C). A manifold placed in an open location should be protected against weather conditions. During winter, protect the manifold from ice and snow. In summer, shade the manifold and cylinders from continuous exposure to direct rays of the sun.

Leave all protective covers in place until their removal is required for installation. This precaution will keep moisture and debris from the piping interior, avoiding operational problems.



Note: All dimensions are approximate.

Total number of cylinders	4	6	8	10	12
Overall manifold length	5'-8"	7'-4"	9'-0"	10'-8"	12'-4"

Floor

FIGURE 1-1 Installation Dimensions

MANIFOLD SPECIFICATIONS

Flow Capability

Oxygen: 2000 SCFH maximum at 50 psig delivery and 2000 psig inlet pressure.

Nitrogen: 3000 SCFH maximum at 160 psig delivery and 2000 psig inlet pressure.

Nitrous Oxide: The flow capability of a Nitrous Oxide cylinder manifold will depend upon conditions at the installation site, demands of the delivery system and the number of cylinders in supply service. Maximum capability is 500 SCFH at 50 psig delivery and 750 psig inlet pressure. Installing a Nitrous Oxide manifold in a location which exposes it to ambient temperatures below 20°F (-7°C) is not recommended. Higher flows are obtainable by adding additional cylinders or heaters, Please call Western for Technical Information.

Breathing Air: 2000 SCFH maximum at 50 psig delivery and 2000 psig inlet pressure.

Helium: 2000 SCFH maximum at 50 psig delivery and 2000 psig inlet pressure.

Carbon Dioxide: The flow capability of a Carbon Dioxide cylinder manifold will depend upon conditions at the installation site, demands of the delivery system and the number of cylinders in supply service. Maximum capability is 500 SCFH at 50 psig delivery and 750 psig inlet pressure. Installing a Carbon Dioxide manifold in a location which exposes it to ambient temperatures below 20°F (-7°C) is not recommended. Higher flows are obtainable by adding additional cylinders or heaters, Please call Western for Technical Information.

Power Source Requirements

A 115 VAC to 24 VAC power supply is provided with the manifold to operate the solenoid valves and alarm lights on the manifold. Under normal operation the manifold will draw a maximum of 1.5 amperes.

A five terminal remote alarm terminal strip is on the right side of the circuit board in the power supply box for remote alarm interfacing. The top three terminals on this strip (N/C, N/O, and C) provide dry contacts for hookup to the hospital or clinic's medical gas alarm system. Contacts are rated up to 3 amps 30 VDC or 2 amps 250 VAC.

Nitrous Oxide and Carbon Dioxide systems include a 500 SCFH capacity heater. The thermostatically controlled heater warms the gas before entering the regulator, preventing "freeze-up". An amber light on the control indicates when the heater circuit is on. The heater operates at 115 VAC and draws approximately four amperes.

Piping Connections

Header Inlets:	Carbon Dioxide	CGA 320
	Nitrous Oxide	CGA 326
	Breathing Air	CGA 346
	Oxygen	CGA 540
	Helium	CGA 580
	Nitrogen	CGA 580
	Medical Breathing Mixtures	CGA 280

Manifold Outlet: 1/2 NPT male pipe thread (located at the middle on top of the cabinet)

Relief Valve: 1/2 NPT male pipe thread (located on the right side on top of the cabinet)

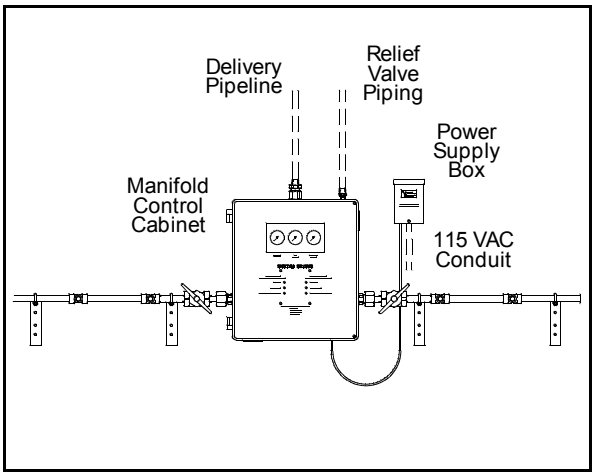


FIGURE 1-2 Connection Locations

Gas	High Pressure Switch	Primary Regulator	Primary Regulator Relief Valve	Low Pressure Switch	Line Regulator	Line Regulator Relief Valve
HQ2	475-525	195-205*	300-360	125-130	50-55	75
HQ2HP	475-525	295-305*	400-500	230-235	170-175	250
HQ2HL	275-325	225-235	300-360	125-130	50-55	75

Unit of measure: all units are in psig

*** Some outlet pressures will vary depending on the inlet pressure to the manifold. All testing must done with full cylinders.**

ADJUSTMENT SPECIFICATIONS

RECOMMENDED TOOLS AND TEST EQUIPMENT

Volt/Ohm meter	Available from local source
Isopropyl alcohol	Available from local source
Phillips screwdriver	Available from local source
Flat blade screwdriver	Available from local source
Needle nose pliers	Available from local source
5/32" hex key wrench	Available from local source
13/16" hex socket wrench	Available from local source
Set of combination wrenches 1/4" thru 1", 1 1/8", 1 3/8", 1 1/2", and 1 3/4"	Available from local source
Fluorolube® S-30 lubricant	Manufactured by Occidental Chemical Corporation Niagara Falls, New York
Liquid leak detector	Available from Western Enterprises Part number LT-100
Teflon® tape	Available from Western Enterprises Part number MTT-1 or MTT-2

Fluorolube is a registered trademark of Occidental Chemical Corporation.
Teflon is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.).

THEORY OF OPERATION

GENERAL INFORMATION

This section concentrates on the basic theory of operation of the components of the automatic changeover manifold.

The first part of this section is an operating summary and traces the flow of gas through the various components of the manifold. The second part of this section explains in detail the operation of the individual components contained in the manifold control section.

GAS FLOW THROUGH THE MANIFOLD

The automatic changeover manifold consists of a manifold control unit and two supply bank headers. The two supply banks alternate between "service" and "reserve" to provide an uninterrupted supply of gas. The manifold control includes the following components and features:

- Green "in service" indicator light for each cylinder bank
- Yellow "ready for use" indicator light for each cylinder bank
- Red "replace depleted cylinders" indicator light for each cylinder bank
- Cylinder bank pressure gauges
- Line pressure gauge
- Safety relief valves
- Automatic bank switching.

Each of the supply banks consist of a header, 24" stainless steel flexible pigtails with integral check valves, individual header valves*, master shut-off valves, and union connections for attachment to the control unit. The main components of the manifold are shown in Figures 2-1 and 2-2. Figure 2-3 shows the piping schematic and the various gas pressure areas. Figure 2-4 is the schematic diagram of the electrical system of the manifold.

* **NOTE:** Manifolds without header valves are constructed utilizing a check valve outlet bushing.

The cylinder bank that supplies the piping system is known as the "Service" supply while the cylinder bank on stand-by is referred to as the "Reserve" supply. Gas flows from the cylinder through the pigtails, check valves, headers, and shut-off valves into the left and right inlets of the control section.

A pressure switch port is located on the inlet block for sensing cylinder pressure for verification of adequate cylinder pressure for stand-by mode. Gas flows through the inlet to the primary regulators on all manifolds except those for Nitrous Oxide and Carbon Dioxide service (Nitrous Oxide and Carbon Dioxide systems include a 500 SCFH capacity heater. The thermostatically controlled heater warms the gas before entering the regulator, preventing "freeze-up" and loss of pressure due to the extreme low temperatures generated when these gases rapidly expand. An amber light on the control indicates when the heater circuit is on). Tubing is connected from the primary regulator high pressure port to the cylinder pressure gauges to sense the supply pressure of the gas in the cylinders.

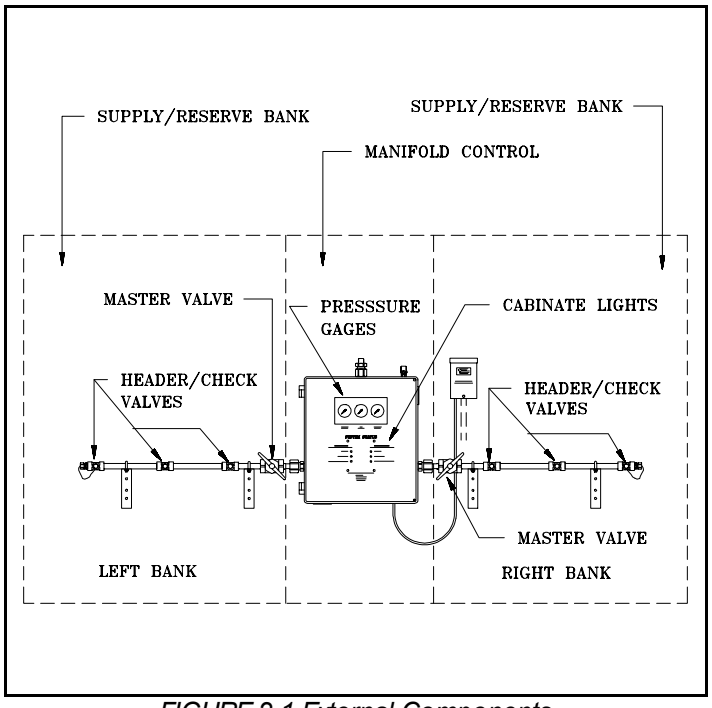


FIGURE 2-1 External Components

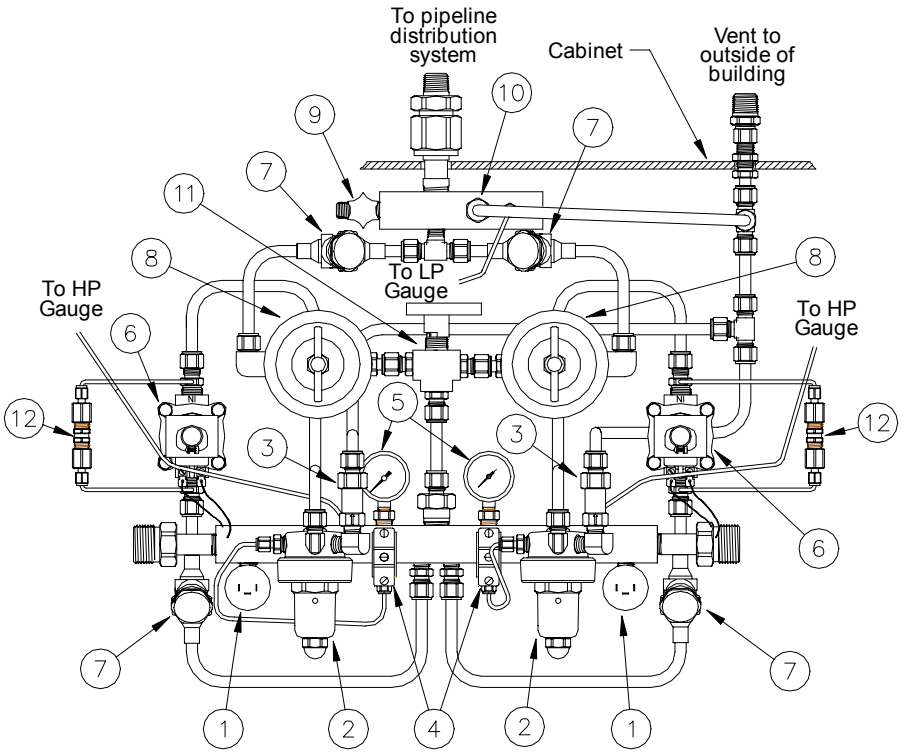


FIGURE 2-2 Internal Components

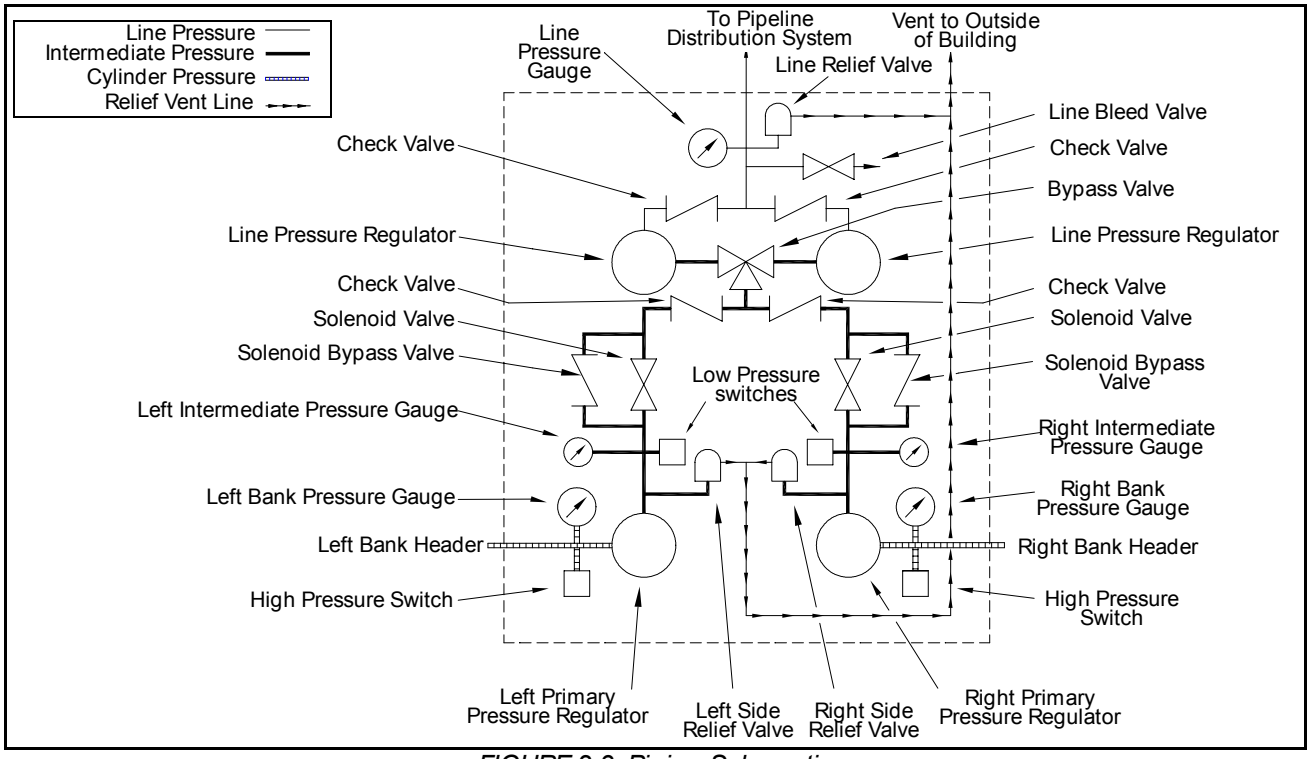


FIGURE 2-3 Piping Schematic

Pressure is reduced in the primary regulators to the pressures noted in the adjustment specification chart located on page 1-3. Both primary regulators are factory preset to deliver the same pressure. The primary regulators have three outlet ports. The first low pressure port is connected (via tubing) to a low pressure switch. A relief valve is connected to the second port. The third port is the gas outlet port, which is connected via tubing to the appropriate solenoid valve.

The gas flows from the primary regulators to the solenoid valves. The solenoid valves are either open or closed depending on which side is in service and whether the "Reserve" cylinders have adequate pressure. The solenoid valve on the side that is in service will be open. The solenoid valve on the "Reserve" side will be closed if the cylinder pressure on that side is above the high pressure switch setting listed in Chart 1 (page 1-3). The "Service" side is determined by whichever side of the manifold is initially pressurized.

Gas on the "Reserve" side is stopped at this point by the closed solenoid valve. The gas from the "Service" side continues to flow, entering a check valve after leaving the solenoid valve. The check valve prevents the gas from flowing backwards towards the solenoid valve when the reserve side is in use.

The gas flows from the check valve into a three way bypass valve. This three way valve toggles the gas between the supply circuit and a bypass circuit. The supply circuit and the bypass circuit are identical. The bypass circuit allows the supply line regulator to be removed without interrupting the gas supply.

The gas flows from the three way valve to the inlet of the line regulator. The line pressure regulator further reduces the pressure to the final pressure delivered to the medical gas piping system. The regulator has one inlet port and three outlet ports. Two of the three outlet ports are not used and are plugged. Gas flows through the third outlet port into a check valve. This check valve keeps gas from back flowing into the line regulator when the bypass circuit is being used.

The gas flows from the check valve into the outlet block assembly. A bleed valve is connected to one outlet port which is only used during field service to set the regulators and switches. Tubing is connected from the second outlet port to the line pressure gauge to sense the pressure of the gas on the downstream side of the line regulator. A line pressure relief valve is also located on the outlet block. This relief valve is connected (via tubing) to the primary regulator relief valves. The tubing is routed from these relief valves to the outside of the control unit for piping to the outside of the building for manifolds located indoors.

The gas flows from the outlet block to the pipeline distribution system.

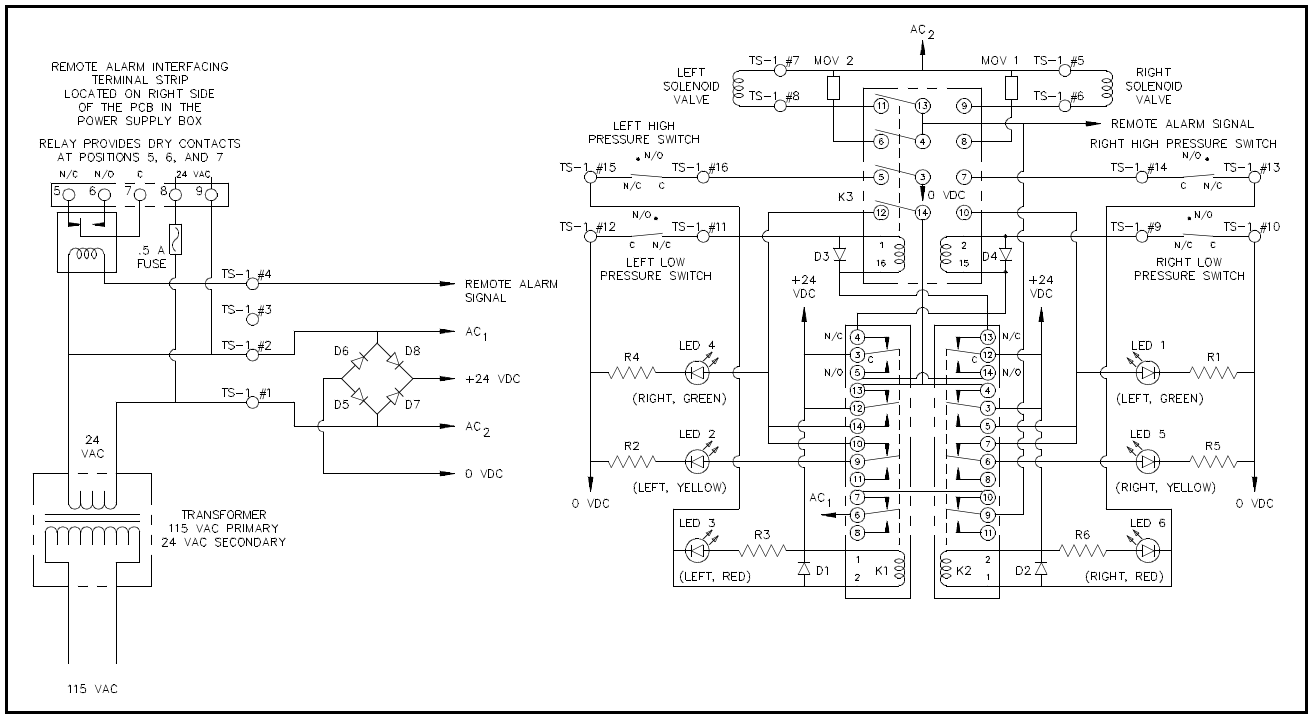


FIGURE 2-4 Electrical Schematic - Non Pressurized

MANIFOLD OPERATION

When both cylinder banks are full, the switches all close causing the solenoid valve on the "Reserve" side to close and activating the system status lights. The "service" side is determined by whichever side of the manifold is pressurized first. The "Service" supply is indicated by the green "in service" light. The "Reserve" supply is indicated by the yellow "ready for use" light.

Changeover from the "Service" to "Reserve" side is accomplished when the "Service" side pressure falls below the set point of the low pressure switch. When this pressure drops to the set point, the low pressure switch is actuated causing the solenoid valve on the "Reserve" side to open. The red "replace depleted cylinders" light on the "Service" side comes on. The "Reserve" bank automatically begins to flow without any interruption in service line delivery pressure.

There are two indicators as to which bank should be changed; the red "replace depleted cylinders" light and the cylinder bank pressure gauge.

After replacing empty cylinders and opening the master and cylinder valves, the cylinder pressure will actuate the high pressure switch, the red "replace depleted cylinders" light will be extinguished and the yellow "ready for use" light will come on. There are no levers or knobs to reposition after replacement of an empty bank.

HIGH PRESSURE SWITCHES

The high pressure switches used in the manifold are diaphragm piston type with one pressure port for sensing gas pressure as shown in Figure 2-5. The switches have three electrical contacts: common, normally closed, and normally open (See Figure 2-6). For proper manifold operation, signal wires are be connected to the common and normally closed terminals.

When the manifold is pressurized to the normal pressures, the piston in the switch is pushed up. The piston pushes the activator of the switch up. This action closes the normally open contact and opens the normally closed contact.

As the gas from the cylinder banks is depleted, the piston moves down, releasing the force against the switch activator. The contacts of the switch then return to the normally open and normally closed positions.

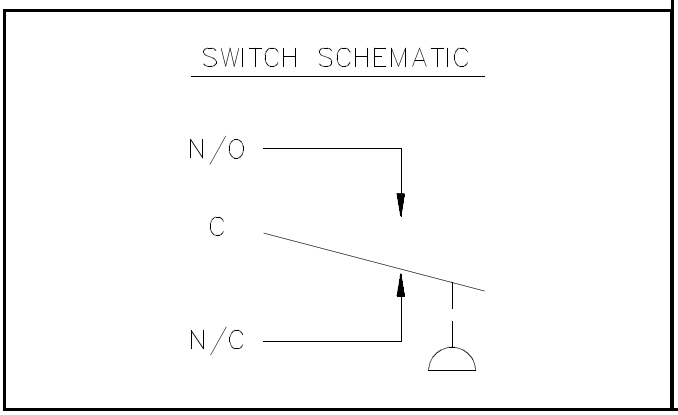


FIGURE 2-6 Switch Schematic

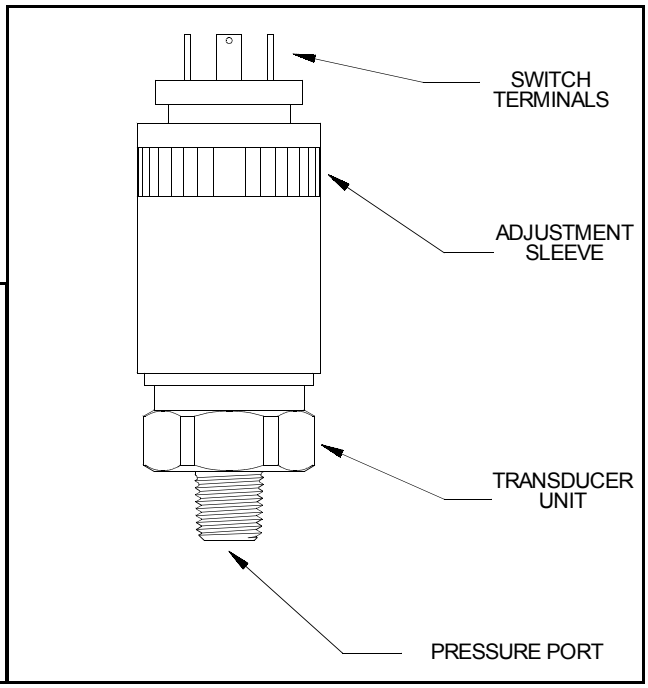


FIGURE 2-5 High Pressure Switch

PRIMARY REGULATORS

The primary regulator's function is to reduce the cylinder pressure of the supply banks to a more usable pressure.

Gas enters the regulator through the inlet port and fills the high pressure chamber and the port to the cylinder contents gauge with gas. See Figure 2-7. Gas in these areas is at the same pressure as the gas in the cylinders. The gas is sealed in this chamber by the seat holder and stem being pushed against the nozzle seal by gas pressure and the body spring. An o-ring seals between the nozzle and the regulator body.

The next area of the regulator is the low (regulated) pressure area of the regulator. This chamber is sealed from the high pressure area by the seat/nozzle assembly and the o-ring around the nozzle and is isolated from the atmospheric pressure by the diaphragm sub-assembly forming a seal around the body of the regulator. The diaphragm is squeezed between the body of the regulator, a slip ring, washer, and the regulator bonnet as the bonnet is tightened down on the body.

The third chamber of the regulator is open to atmospheric pressure. This chamber contains the regulator bonnet, adjusting screw, pivot, bonnet spring, washer, and the top side of the diaphragm sub-assembly.

As the adjusting screw is turned in against the pivot, the bonnet spring is compressed and puts a downward force on the diaphragm sub-assembly. The bottom of the diaphragm sub-assembly is in direct contact with the seat holder and stem. When the diaphragm is forced down by the spring, the stem is pushed away from the nozzle and gas can then flow from the high pressure chamber to the low pressure chamber.

When the low pressure chamber fills with gas, the gas will push upward against the diaphragm sub-assembly. As the pressure continues to build in the low pressure chamber, more upward force will be exerted against the diaphragm and the diaphragm will push up against the bonnet spring compressing the bonnet spring. As the diaphragm is gradually raised by the gas pressure, the seat and nozzle gradually come closer together filling the low pressure chamber slowly and eventually the upward pressure exerted by the gas will be slightly greater than the downward pressure of the bonnet spring and the seat nozzle will close. As gas is released from the low pressure chamber, a proportional amount of gas will be let into the low pressure area from the high pressure chamber. As the adjusting screw is turned in farther and the bonnet spring compressed, the gas pressure required to lift the diaphragm increases, resulting in a higher delivery pressure from the outlet port of the regulator.

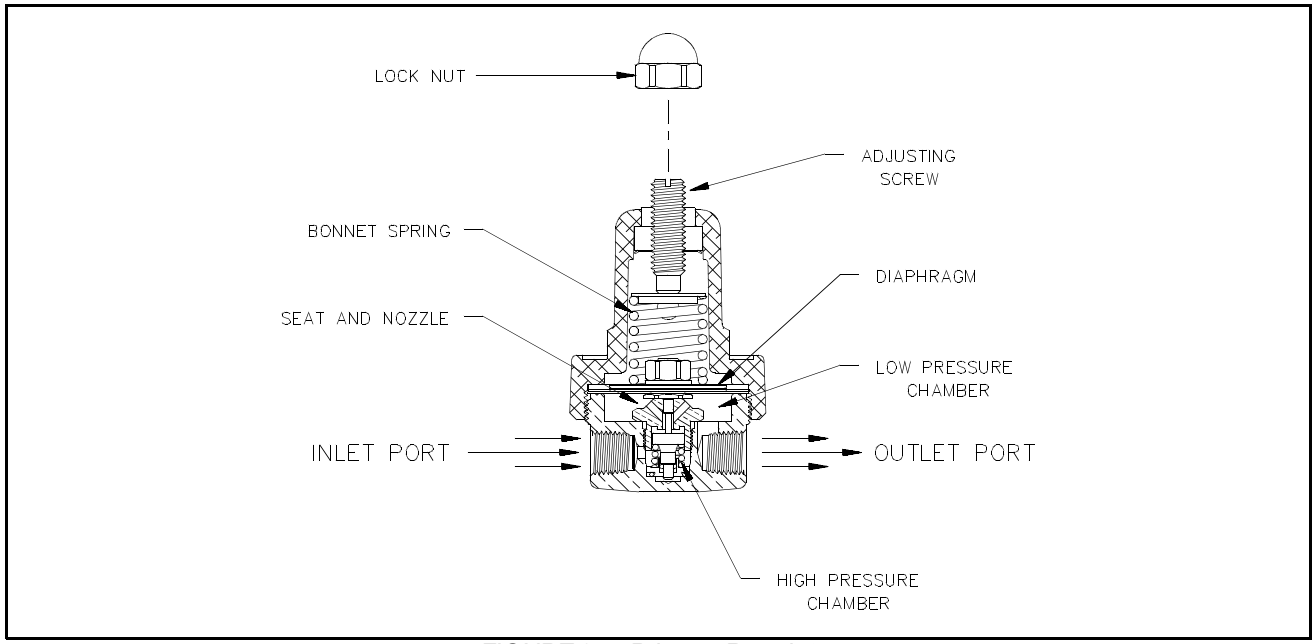


FIGURE 2-7 Primary Regulator

LOW PRESSURE SWITCHES

The low pressure switches used to signal "Reserve in Use" are piston type with one common contact, one normally closed contact, and one normally open contact. See Figures 2-6 and 2-8.

When the manifold is pressurized to the normal pressures, the piston in the switch is pushed up. The piston pushes the activator of the switch up. This action closes the normally open contact and opens the normally closed contacts.

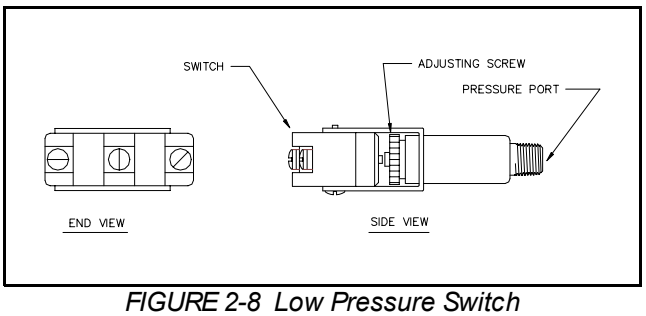


FIGURE 2-8 Low Pressure Switch

As gas from the cylinder banks is depleted, the piston moves down, releasing the force against the switch activator. The contacts of the switch then return to the normally open and normally closed positions.

The switches complete the electrical circuits to the indicators on the front of the control section and to the remote alarm interface board in the power supply box.

SOLENOID VALVES

The solenoid valves are the heart of the manifold for maintaining the stand-by or reserve bank. The solenoid valves are constructed of two basic functional units: a solenoid (electromagnet) with its core and a valve body containing one or more orifices. See Figure 2-9. Flow through an orifice is stopped or allowed by the action of the core when the solenoid is energized or de-energized. The solenoid is mounted directly on the valve body. The core is enclosed and free to move in a sealed tube providing a compact, packless assembly.

The valve has a pilot and bleed orifice and utilizes the line pressure for operation. When the solenoid is energized, the pilot orifice is closed and full line pressure is applied to the top of the diaphragm through the bleed orifice, thereby providing a seating force for tight closure. When the solenoid is de-energized, the core opens the pilot orifice and relieves pressure from the top of the valve diaphragm to the outlet side of the valve. This results in an unbalanced pressure which causes the line pressure to lift the diaphragm off the main orifice, thereby opening the valve.

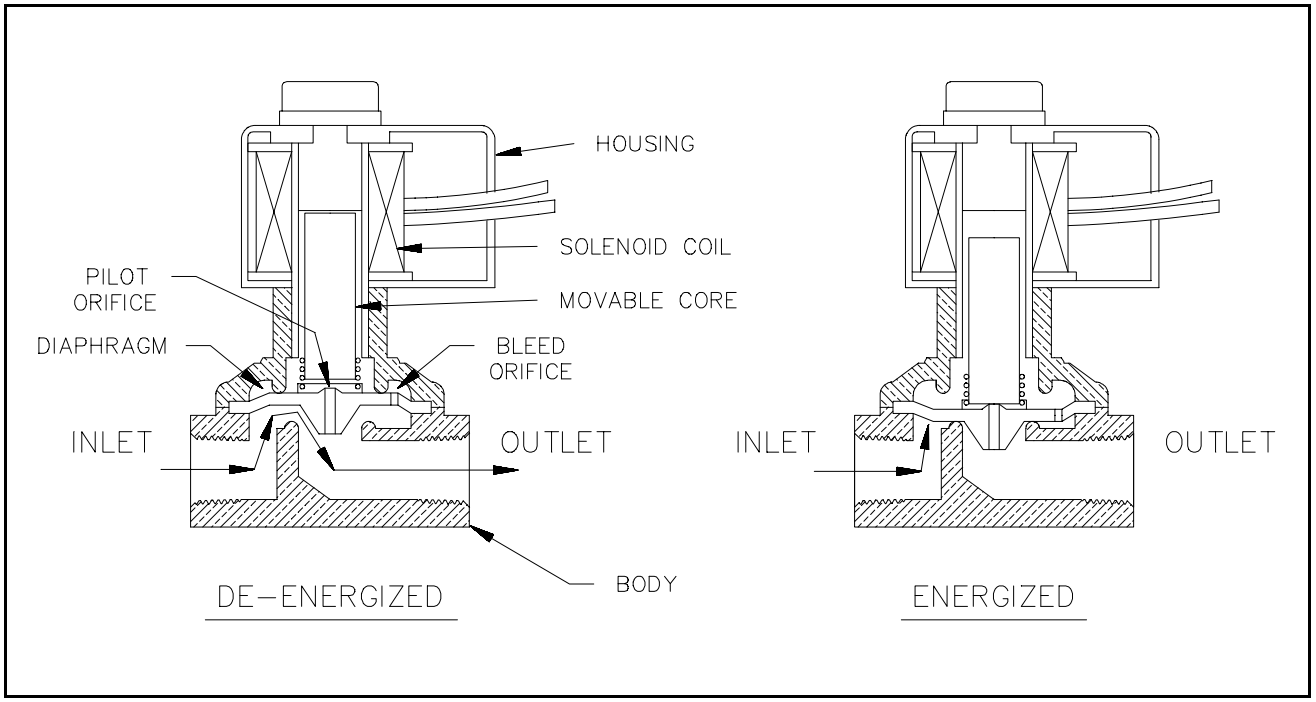


FIGURE 2-9 Solenoid Valve

CHECK VALVES

The check valves prevent gas from flowing backward from the intermediate pressure area to the solenoid valve and primary regulator. See Figure 2-10.

Gas enters the check valve from the solenoid valve and pushes the check valve seat assembly away from the sealing surface of the valve body. This allows the gas to flow to the outlet port of the valve. When the gas flow stops, the spring of the check valve pushes the valve seat down on the sealing surface preventing any gas flow backward through the valve.

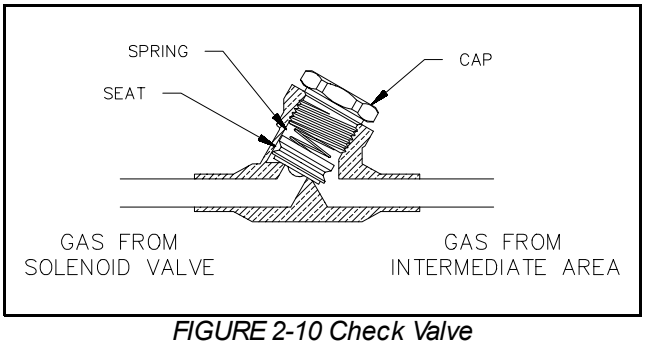


FIGURE 2-10 Check Valve

SOLENOID BYPASS

The bypass is to provide gas to the outlet of the solenoid in case the outlet fitting leaks. The bypass will ensure that the maximum pressure differential across the solenoid is not exceeded.

Gas enters the inlet of the bypass check valve from the solenoid inlet. Gas also enters the outlet of the bypass from the outlet of the solenoid. During normal operation the inlet and the outlet pressures are equal. The bypass check valve is set around 130 psig, (it takes 130 psig differential from the inlet to the outlet to open the bypass check valve). The only time this check valve will open is if the solenoid outlet fitting leaks. If the outlet fitting leaks the bypass check valve will open and permit gas to flow. This flow of gas will ensure that the maximum allowable differential pressure of the solenoid is not exceeded.

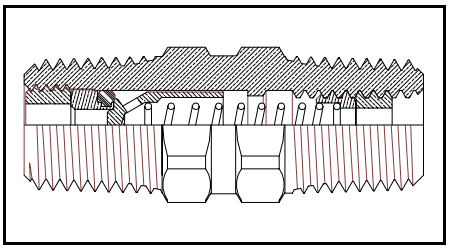


FIGURE 2-11 Solenoid Bypass Valve

LINE PRESSURE REGULATORS

The line pressure regulator used in the manifold is a single stage, four port adjustable regulator. The regulator utilizes a tied diaphragm/valve seat design to achieve maximum flow rates. Refer to Figure 2-12. It has one inlet port and three outlet ports. The inlet port is piped to an intermediate pressure port in the manifold block. One outlet port is piped to the outlet of the manifold for connection to the main pipeline. One port is connected to the delivery line pressure gauge and the other outlet port is connected to a bleed valve for use in field adjustment.

Gas enters the regulator through the inlet port and with the adjusting screw backed away from the spring, is sealed in the high pressure chamber of the regulator by the seat and nozzle.

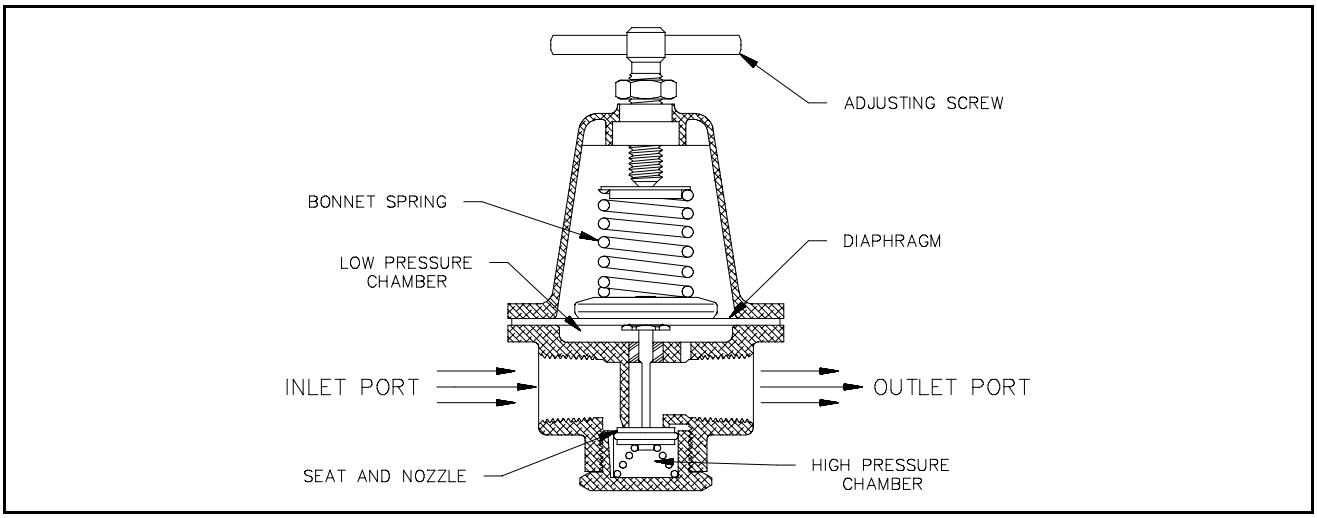


FIGURE 2-12 Line Regulator

As the adjusting screw is turned in, it compresses the spring and puts a downward force on the diaphragm sub-assembly. The bottom of the diaphragm sub-assembly is connected to the seat holder. When the diaphragm is forced down by the spring, the stem is pushed away from the nozzle and gas can then flow from the high pressure chamber to the low pressure chamber.

When the low pressure chamber fills with gas, the gas will push upward against the diaphragm sub-assembly. As the pressure continues to build in the low pressure chamber, more upward force will be exerted against the diaphragm and the diaphragm will push up against the bonnet spring compressing the bonnet spring. As the diaphragm is gradually raised by the gas pressure, the seat and nozzle gradually come closer together filling the low pressure chamber slowly and eventually the upward pressure exerted by the gas will be slightly greater than the downward pressure of the bonnet spring and the seat nozzle will close. As gas is released from the low pressure chamber, a proportional amount of gas will be let into the low pressure area from the high pressure chamber. As the adjusting screw is turned in farther and the bonnet spring compressed, the gas pressure required to lift the diaphragm increases, resulting in a higher delivery pressure from the outlet port of the regulator.

THREE WAY BALL VALVE

The three way valve determines which line regulator will be in service (see Figure 2-13). Rotating the knob 1/2 turn the changes the direction of gas flow and causes the bypass line regulator to become the service line regulator.

Gas enters the three way valve through the inlet port.. The gas then enters the flow directional ball. The directional flow of the gas is determined by the orientation of the valve handle. The direction of gas flow can be changed by rotating the valve handle 1/2 turn.

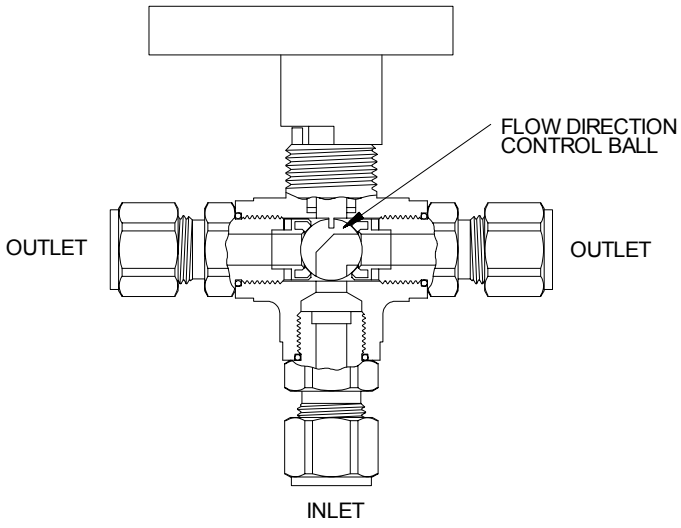


FIGURE 2-13 Three Way Ball Valve

FIELD TESTING & TROUBLE-SHOOTING

The manifold performance tests are used to verify the manifold functional performance. When used in conjunction with the trouble-shooting charts, the technician can verify proper performance or rapidly identify the probable source of the problem.

PERFORMANCE VERIFICATION PROCEDURE

NOTE: It may be necessary to pipe the bleed valve line outside to vent the system during testing. The bleed valve is equipped with a CGA 022 RH connection, 9/16-18UNF-2A right hand thread, for utilization of a hose connection. The hose can be installed after completing step 1 below.

1. Open the manifold cover by removing the two screws in the right side corners. The cover is hinged on the left side.
2. Open the master valves located on the cylinder headers prior to pressurizing the manifold.
3. S-l-o-w-l-y open one cylinder valve on the left bank of cylinders.
4. S-l-o-w-l-y open one cylinder valve on the right bank of cylinders.
5. Using a leak detect solution, verify that there are no leaks present at the connections.
6. Close the left and right cylinder valves.
7. Open the bleed valve in the manifold to vent the system until all gas has been removed from the manifold.
8. Close the bleed valve.
9. Connect the electrical power source and supply electrical power to the manifold.
10. Observe the cabinet system status indicators. Verify that both green indicators and both red indicators are lit.
11. S-l-o-w-l-y open one cylinder valve on the left bank of cylinders.
12. Open the bleed valve so as to create a slight flow of gas through the manifold.
13. Close the bleed valve.
14. Verify that the left intermediate gauge indicates the pressure as shown in the specification chart in Section 1 for the primary regulator pressure (page 1-3). Adjust the left primary regulator as necessary to obtain the required pressure.
15. Observe the intermediate gauge for two minutes. Verify that the primary regulator does not exhibit "creep" or an increase in pressure.
16. Verify that the left side cylinder contents gauge indicates a minimum of 1400 psig for Oxygen, Nitrogen, Air, or gas mixtures systems. Nitrous Oxide and Carbon Dioxide systems should indicate a minimum of 600 psig.
17. Verify that the line pressure gauge is indicating a minimum of 50 psig on all systems except Nitrogen. Nitrogen should indicate a minimum of 160 psig. Adjust to the proper line pressure if necessary.
18. Open the bleed valve so as to create a slight flow of gas through the manifold.
19. Turn off the left cylinder valve and allow all gas to vent from the manifold.
20. Close the bleed valve.
21. S-l-o-w-l-y open one cylinder valve on the right bank of cylinders.
22. Open the bleed valve so as to create a slight flow of gas through the manifold.
23. Close the bleed valve.

24. Verify that the right intermediate gauge indicates the pressure as shown in the specification chart in Section 1 for the primary regulator pressure (page 1-3). Adjust the right primary regulator as necessary to obtain the required pressure.

25. Observe the intermediate gauge for two minutes. Verify that the primary regulator does not exhibit "creep" or an increase in pressure.

26. Verify that the right side cylinder contents gauge indicates a minimum of 1400 psig for Oxygen, Nitrogen, Air, or gas mixtures systems. Nitrous Oxide and Carbon Dioxide systems should indicate a minimum of 600 psig.

27. Verify that the line pressure gauge is indicating a minimum of 50 psig on all systems except Nitrogen. Nitrogen should indicate a minimum of 160 psig. Adjust to the proper line pressure if necessary.

28. Verify that the line pressure regulator is functioning properly by observing the line pressure gauge for two minutes. The gauge should indicate the same pressure at the end of the two minute period.

29. Open the bleed valve to create a slight flow of gas through the manifold.

30. Verify that the line pressure regulator maintains a constant pressure by observing the line pressure gauge.

31. Close the bleed valve.

32. Verify the cabinet system status indicators. The green indicator on the right side should be lit signifying that the right bank of cylinders is in service. The red indicator on the left side should be lit signifying that the left side of the manifold has not been pressurized.

33. S-l-o-w-l-y open one cylinder valve on the left bank of cylinders.

34. Observe the cylinder contents pressure gauges to verify cylinder pressure.

35. Observe the cabinet system status indicators. The red indicator on the left side should have been extinguished and the yellow "ready for use" indicator should be lit.

36. Close the cylinder valve on the right bank of cylinders.

37. Open the bleed valve to create a slight flow of gas through the manifold while observing the cylinder contents gauges. The right cylinder bank gauge should begin to drop (in oxygen manifold units there will be a pressure rise before the pressure will drop); the left cylinder bank gauge should remain constant.

38. Observe the intermediate pressure gauge as the right side pressure continues to drop.

39. As the cylinder pressure drops on the right side, the intermediate area also loses pressure. Verify that the pressure falls to the set point of the low pressure switch on the right side (see the specification chart in Section 1), the left solenoid valve then opens and the right intermediate pressure should stay at the low pressure switch set point.

40. Close the bleed valve.

41. Observe the cabinet system status indicators. The green indicator on the left side should be lit signifying that the left bank of cylinders is in service. The red indicator on the right side should be lit signifying that the right side of the manifold is not pressurized.

42. S-l-o-w-l-y open one cylinder valve on the right bank of cylinders.

43. Observe the cylinder contents pressure gauges to verify cylinder pressure.

44. Observe the cabinet system status indicators. The red indicator on the right side should have been extinguished and the yellow "ready for use" indicator should be lit.

45. Close the cylinder valve on the left bank of cylinders.

46. Open the bleed valve to create a slight flow of gas through the manifold while observing the cylinder contents gauges. The left cylinder bank gauge should begin to drop (in oxygen manifold units there will be a pressure rise before the pressure will drop); the right cylinder bank gauge should remain constant.

47. Observe the intermediate pressure gauge as the left side pressure continues to drop.

48. As the cylinder pressure drops on the left side, the intermediate area also loses pressure. Verify that the pressure falls to the set point of the low pressure switch on the left side (see the specification chart in Section 1), the right solenoid valve then opens and the left intermediate pressure should stay at the low pressure switch set point.

49. Close the bleed valve.

50. Observe the cabinet system status indicators. The green indicator on the right side should be lit signifying that the right bank of cylinders is in service. The red indicator on the left side should be lit signifying that the left side of the manifold is not pressurized.

51. Remove the cover from the power supply box and connect an ohmmeter across the normally open (N/O) and common (C) terminals on the right side of the circuit board terminals # 6 and # 7 respectively). Verify an ohmmeter reading of infinite resistance.

52. S-l-o-w-l-y open one cylinder valve on the left bank of cylinders.

53. The ohmmeter should register approximately zero (0) ohms resistance as soon as the cylinder pressure on the left side increases above 500 psig. (300 psig for HQ2HL manifolds).

54. Close the cylinder valve on the right bank of cylinders.

55. Open the bleed valve to create a slight flow of gas through the manifold while observing the cabinet system status lights.

56. As soon as the manifold status indicators change, the ohmmeter should read infinite resistance.

57. Close the bleed valve.

58. S-l-o-w-l-y open one cylinder valve on the right bank of cylinders.

59. The ohmmeter should register approximately zero (0) ohms resistance as soon as the cylinder pressure on the right side increases above 500 psig. (300 psig for HQ2HL manifolds).

60. Close the cylinder valve on the left bank of cylinders.

61. Open the bleed valve to create a slight flow of gas through the manifold while observing the cabinet system status lights.

62. As soon as the manifold status indicators change, the ohmmeter should read infinite resistance.

63. Close the bleed valve.

64. Close the cylinder valve on the right bank of cylinders.

65. Open the bleed valve and vent all remaining gas from the manifold. Verify that the ohmmeter continues to read infinite resistance.

66. Observe the cabinet system status indicators. Both green indicators and both red indicators should be lit.

67. Close the bleed valve. Remove the hose connection used to vent gas to the outside, if applicable.

68. Close the manifold cover using the two screws in the corners on the right side of the cover to secure it.

69. Remove the ohmmeter leads from the connections in the power supply box and reinstall the box cover.

TROUBLE-SHOOTING (Only qualified repair personnel should make repairs)

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
CABINET INDICATOR LIGHTS		
No indicator lights on front panel come on when power is hooked up.	Power Input.	Check electrical power supply.
	Internal wiring disconnected.	Check all wiring connections.
	Manifold controller PCB defective.	Replace manifold controller PCB.
Red Indicator light is on but both banks are full. (Note: Full cylinder pressure is considered to be pressure above the high pressure switch setting-see page 1-3).	Master valve, header valves, or cylinder valves on bank are closed.	Slowly open valves.
	Low pressure switch set to open above the primary regulator setting.	Adjust pressure switch or return faulty unit for factory setting.
	Primary regulator setting below the low pressure switch setting.	Set primary regulator delivery pressure to specifications.
	Bank pressure below high pressure switch setting.	Replace cylinders if below switch factory setting. Adjust pressure switch if necessary.
Red indicator light does not come on when one bank is empty and changeover occurs.	Light burned out.	Replace manifold controller PCB.
Red indicator light does not come on when one bank is empty. Changeover does not occur.	Low pressure switch set to open at zero pressure.	Adjust pressure switch or return faulty unit for factory setting.
Green indicator light does not come on even though bank is in service.	Low pressure switch wiring disconnected.	Check wiring connections.
	Manifold controller PCB defective.	Replace manifold controller PCB.
Yellow indicator light comes on even though one bank of cylinders is empty.	High pressure switch set to open at too low a pressure.	Adjust pressure switch or return faulty unit for factory setting.
Yellow indicator light is on when side should be in service.	Low pressure switch wiring disconnected.	Check wiring connections.
	Flow capacity too high forcing premature changeover.	Reduce flow demand.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
'RESERVE IN USE' SIGNAL		
Remote alarm signal stays in one mode constantly regardless of changeover status.	Power supply wiring is incorrect.	Check wiring connections on both power supply terminal strips.
	Flow demand too high.	Reduce flow demand.
	Power supply PCB defective.	Replace power supply PCB.
Remote alarm signals are opposite of manifold status.	Faulty connection to remote alarm unit.	Check input from alarm unit to terminal strip.
'ABNORMAL' LINE PRESSURE SIGNAL		
Low pressure alarm activated.	Line pressure regulator improperly adjusted.	Readjust line pressure regulator.
	Closed master valves, header valves, or cylinder valves.	Slowly open valves.
	Empty cylinders.	Replace with full cylinders.
	Primary regulator setting too low.	Set delivery pressure to specifications.
	Faulty line pressure gauge.	Replace line pressure gauge.
	Faulty alarm pressure switch.	Readjust or replace pressure switch as necessary.
High pressure alarm activated.	Line regulator setting too high.	Readjust line pressure regulator.
	Regulator freeze-up. (Nitrous oxide or carbon dioxide)	Reduce the flow demand or increase the number of supply cylinders.
	Faulty line pressure gauge.	Replace line pressure gauge.
	Faulty alarm pressure switch.	Readjust or replace pressure switch as necessary.
LOSS OF CYLINDER CONTENTS		
Audible or inaudible gas leakage (unknown origin).	Leakage at manifold piping connections.	Tighten, reseal or replace.
	Leakage at manifold tubing connections.	Tighten, reseal or replace.
	Leakage in downstream piping system.	Repair as necessary.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
LOSS OF CYLINDER CONTENTS (continued)		
Audible or inaudible gas leakage (unknown origin). (continued)	Leakage at cylinder valve.	Replace cylinder.
	Gauge leaks.	Reseal or replace.
	Regulator leaks.	Repair or replace.
Venting at relief valve.	Line regulator setting too high.	Set delivery pressure to specifications.
	Overpressure due to creeping or faulty regulation by primary regulator.	Replace regulator seat and nozzle components.
	Overpressure due to creeping or faulty regulation by line regulator.	Replace regulator seat and nozzle components.
	Regulator freeze-up. (Nitrous oxide or carbon dioxide)	Reduce the flow demand or increase the number of supply cylinders.
	Heater failure. (Nitrous oxide or carbon dioxide)	Reduce the flow demand or increase the number of supply cylinders.
Gas leakage around regulator body or bonnet.	Loose bonnet.	Tighten bonnet.
	Diaphragm leak on regulator.	Replace diaphragm.
Gas leakage around valve stem or packing nut on master valve or header valve.	Valve packing leaks.	Tighten packing nut.
	Faulty valve.	Repair or replace valve.
LOSS OF RESERVE BANK CONTENTS		
Both banks feeding.	Solenoid valve seat leak.	Replace solenoid valve.
	Faulty primary regulator.	Replace regulator seat and nozzle components.
	Loss of electrical power.	Check electrical power supply.
	Faulty primary regulator.	Replace regulator seat and nozzle components.
	Faulty solenoid bypass check valve.	Replace solenoid bypass.

SYMPTOM	PROBABLE CAUSE	REMEDY OR CHECK
LOSS OF RESERVE BANK CONTENTS (continued)		
Opposite bank feeding.	Solenoid valve wiring incorrect.	Swap wiring from one solenoid valve to the other. Reduce flow demand. Set delivery pressure per specifications.
Premature changeover to reserve bank.	Flow demand too high.	Readjust line pressure regulator.
	Primary regulator setting too low.	Readjust line pressure regulator.
PIPELINE DISTRIBUTION		
Pipeline not at desired pressure.	Line regulator not set correctly.	Consult factory.
Required gas flow not available.	Line regulator not set correctly. Flow demand too high.	
MANIFOLD LOCKS UP OR WON'T FLOW		
Reserve bank won't flow, or the manifold locks up and neither bank will flow.	Leakage at outlet fitting of the solenoid that will not open.	1) Remove power from the system. 2) Close valves on the cylinders. 3) Deplete gas from the headers by cracking open a fitting. 4) Tighten solenoid outlet fitting. 5) Open the cylinder valves. 6) Reconnect power to the manifold.
	Primary regulator set pressure 150 psig higher than the changeover pressure.	1) Remove power from the system. 2) Close valves on the cylinders. 3) Deplete gas from the headers by cracking open a fitting. 4) Reset the primary regulator. 5) Open the cylinder valves. 6) Reconnect power to the manifold.

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SERVICE PROCEDURES

GENERAL MAINTENANCE

1. Main section
   a) Daily - record line pressure.
   b) Monthly
      1) Check regulators, valves and compression fittings for external leakage.
      2) Check valves for closure ability.
   c) Annually
      1) check relief valve pressures.
      2) Check regulator seats
2. Manifold header
   a) Daily - observe Nitrous Oxide and Carbon Dioxide systems for cylinder frosting or surface condensation. Should excessive condensation or frosting occur it may be necessary to increase the number of cylinders or add external heaters.
   b) Monthly
      1) Inspect valves for proper closure.
      2) Check cylinder pigtails for cleanliness, flexibility, wear, leakage, and thread damage. Replace damaged pigtails immediately.
      3) Inspect pigtail check valves for closure ability.
   c) Every 4 Years
      1) Replace all pigtails

WARNING

- Repairs to manifold high pressure regulators, valve connections and piping should be made only by qualified personnel. Improperly repaired or assembled parts could fly apart when pressurized causing death or serious injury.

SAFETY PRECAUTIONS

1. Examine all parts before repair. Note: Because manifold parts may be exposed to high pressure Oxygen and Nitrous Oxide and the condition of the unrepaired parts is unknown, a repair-inspection should be performed before exposing the parts to high pressure gas.
2. Keep manifold parts, tools and work surfaces free of oil, grease and dirt. These and other flammable materials may ignite when exposed to high pressure Oxygen or Nitrous Oxide.
3. Use only proper repair tools and parts. Parts for Western manifolds are shown in this instruction. Special tools are called out as needed.
4. Before connecting the cylinder to the manifold, momentarily open and close the cylinder valve to blow out any dirt or debris.
5. After connecting the cylinder to the manifold, open the cylinder valve s-l-o-w-l-y to allow the heat of compression to dissipate.
6. Use only cleaning agents, sealants, and lubricants as specified in this instruction.

CLEANING, LUBRICATION, AND SEALING

Clean metal parts of the manifold with isopropyl alcohol prior to assembly. Dry thoroughly. Do not clean o-rings with this solvent (Freon TF is acceptable).

Teflon® Tape Application

Threaded pipe connections should be sealed with Teflon® tape.

Remove the old sealant from both male and female threads. Apply Teflon® tape to the male pipe thread. Approximately 1 1/2 turns of tape should be sufficient. Do not cover the first thread with tape. Assemble the fittings wrench tight to effect a gastight seal.

Assembly and Disassembly of Compression Fittings

Mark the fitting and nut prior to disassembly. Before retightening, make sure the assembly has been inserted into the fitting until the ferrule seats in the fitting. Retighten the nut by hand. Torque the nut with a wrench until the marks line up, which indicates that the fitting has been tightened to its original position. A noticeable increase in mechanical resistance will be felt indicating the ferrule is being resprung into sealing position. Then snug the nut 1/12 of a turn (1/2 of a wrench flat) past the original position.

Leak Testing

There are four types of manifold piping connections: sealed (soldered), threaded (unions and elbows), compression (tubing connections), and gasket (diaphragms and o-rings).

When a leak is suspected and cannot be easily located, a leak detector solution should be applied to all connections (in the event of leaks at more than one connection). Be certain to wipe fittings dry after testing to prevent corrosion (Western's LT-100 leak detector dries clean and will not harm apparatus).

If a leak is detected at:

sealed *connections,* replace the assembly which is joined by the leaking connection.

threaded connections, union sealing surfaces may have burrs or nicks which may be polished out. Be certain to clean parts before reassembly. If the surface will not seal, replace the union. Elbows and tees may be cleaned of old sealant and resealed with Teflon® tape. Refer to cleaning, sealing, and lubricating instructions.

compression fittings, sealing surfaces of fittings or brass ferrules may be damaged and must be replaced. Refer to the parts list for appropriate tubing.

gasket seals, leaks may occur at seals made by gaskets such as diaphragms or o-rings. Gas may leak to atmosphere or across the seal into the opposite pressure circuit. External leaks are evidenced by application of leak detector while leaks across the seal are detected by faulty manifold function. When replacing seals, use care not to damage sealing surfaces.

GENERAL REPAIR PROCEDURES

Be sure all pressure and electrical power is removed from the system prior to initiating any repair procedures.

WARNING

- Do not shutdown the manifold until all personnel have been advised of the intended service and all patients requiring medical gas are being supplied from portable supplies. Patients still on the manifold pipeline will not receive gas.

Replace parts with all components in the repair kit.

HOW TO SHUTDOWN THE MANIFOLD*

1. Turn off the piping system isolation valve, if present. If an isolation valve is not present, the entire building's gas system will be reduced to atmospheric pressure. WARNING: Do not shutdown the manifold until all personnel have been advised of the intended service and all patients requiring medical gas are being supplied from portable supplies.
2. Turn off right and left supply bank cylinder valves.
3. Open the manifold cover by removing the two screws in the corners on the right side and open the bleed valve to vent residual gas. Residual gas could also be vented by loosening the manifold outlet connection to the supply main.
4. Close the bleed valve. Tighten the manifold outlet connection if gas was vented by that method.
5. Disconnect electrical power from the manifold at the main power source.

*Just removing the power will not shut the manifold down.

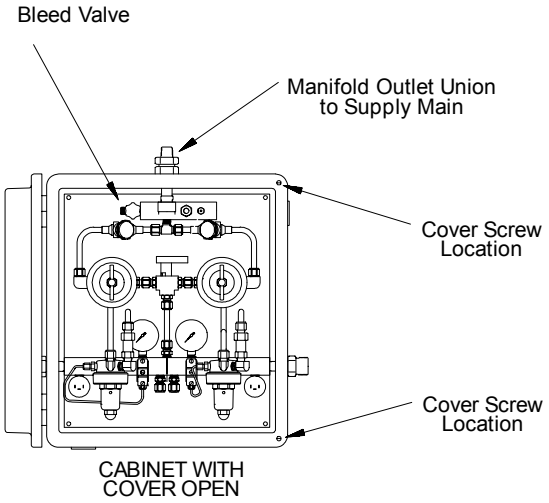


FIGURE 4-1 Cabinet Manifold

HIGH PRESSURE SWITCH REPLACEMENT

Refer to Figure 4-2

Removal

1. Shutdown the manifold as explained earlier.
2. Disconnect the wiring from the pressure switch.
3. Using a 1-1/4 open end wrench remove the pressure switch from the inlet block.
4. Remove old sealant from the pipe fitting.

Replacement

1. Apply Teflon® tape to the 1/4 NPT male pipe thread of the pressure switch inlet fitting.

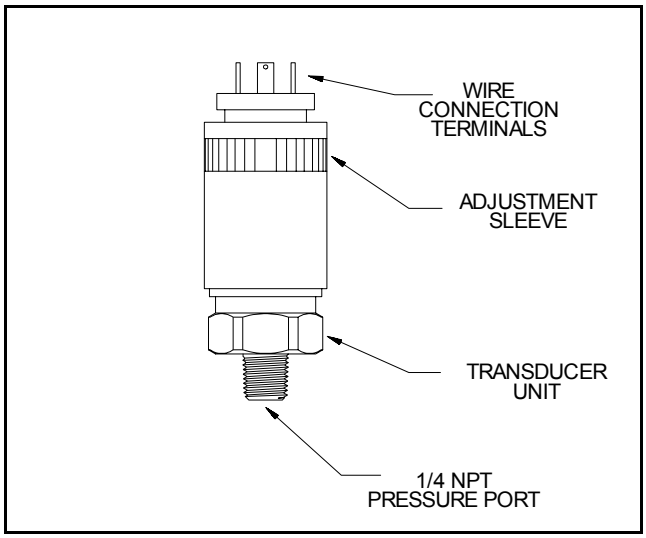


FIGURE 4-2 High Pressure Switch

4. Using a 1-1/4 open end wrench install the pressure switch into the inlet block.

6. Complete the adjustment instructions below prior to installing the signal wires to the pressure switch.

Pressure Switch Adjustment

CAUTION:

- Adjusting nut will turn easily until it hits a stop. Do not over torque; over torquing may cause damage. A damaged switch may burst or fly apart when pressurized.

1. The plastic housing is rotated to adjust the pressure switch.
2. Connect an ohmmeter to the normally closed and common electrical contacts on the switch. The ohmmeter should register zero resistance.
3. Begin pressurizing the manifold by opening one cylinder valve on the side of the manifold the switch is on.
4. Observe the cylinder pressure gauge and the ohmmeter to determine switch setting:

   At the actuation pressure, the ohmmeter reading should jump from zero resistance to infinite resistance.

5. Cycle between actuation and reactuation signals and make adjustment to the nut as required to achieve the signal setting per the Adjustment Specifications chart in Section 1. The actuation pressure setting should be made on increasing pressure only. The reacutation point will be slightly lower than the acuation point.

WARNING:

- Be sure power is off when electrical connections are made. Current flowing through the wires may shock the service technician.

6. After the setting has been made, connect the signal wires to the common (C) and normally closed (N/C) contacts on the pressure switch.

LOW PRESSURE SWITCH REPLACEMENT

Refer to figure 4-3

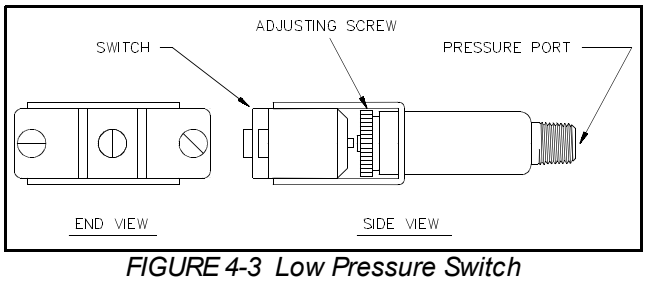


FIGURE 4-3 Low Pressure Switch

Removal

1. Shutdown the manifold as explained earlier in this section.
2. Loosen the slot head screws on the pressure switch using a flat blade screwdriver and remove the wires.
3. Using a 13/16" open end wrench, remove the pressure switch from the mounting block.
4. Remove old sealant from the threads in the mounting block.

CAUTION:

- Do not stand directly in front of the valve when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

5. Blow out the internal pipe threads with oil free Air or Nitrogen to remove all foreign material.

Replacement

1. Apply Teflon® tape to the pipe threads on the new pressure switch.
2. Install the pressure switch in the mounting block using a 13/16" open end wrench and tighten to effect a gas tight seal.
3. Complete the adjustment instructions below prior to installing the signal wires to the pressure switch.

Pressure Switch Adjustment

1. Connect an ohmmeter to the normally closed and common electrical contacts on the switch. The ohmmeter should register zero resistance.
2. Begin pressurizing the manifold by opening one cylinder valve on the side of the manifold the switch is on: At the actuation pressure, the ohmmeter reading will jump from zero resistance to infinite resistance.
3. Close the cylinder valve.
4. Open the bleed valve slightly to relieve pressure from the manifold while observing the intermediate pressure gauge and ohmmeter to determine switch setting:
   At actuation pressure, the ohmmeter reading should drop from infinite resistance to zero resistance.
5. Close the bleed valve.
6. Using a flat blade screwdriver, turn the knurled adjustment screw on the pressure switch clockwise to raise the set point or counterclockwise to lower the set point. The pressure switch should be set per the Adjustment Specification chart in Section 1.
7. Cycle between actuation and reactuation signals and make adjustments as required to achieve the signal setting. The setting should be made on descending pressure. Make adjustments in response to the reading obtained in step 4.

WARNING:

- Be sure power is off when electrical connections are made. Current flowing through the wires may shock the service technician.

8. After the setting has been made, connect the signal wires to the common (C) and normally closed (N/C) contacts on the pressure switch.

MANIFOLD CONTROLLER PRINTED CIRCUIT BOARD REPLACEMENT

Refer to Figures 4-4 and 4-5

Removal

1. Shutdown the manifold as explained earlier in this section.

2. Disconnect the plug from the top of the circuit board by grasping the plug on each end with one hand and stabilizing the circuit board with the other. Work the plug back and forth side to side slightly while pulling up until it releases.

3. Press the locking feature of one circuit board support and pull the circuit board away from the manifold cover slightly until the circuit board slides over the lock.

4. Do the same at the other three corners of the circuit board.

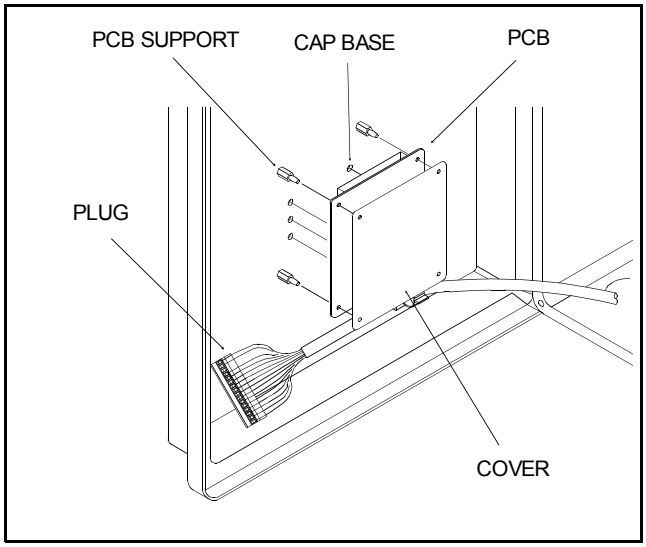


FIGURE 4-4 Printed Circuit Board

5. Slide the circuit board and cover completely off of the supports.

6. Save the circuit board cover for installation with the new circuit board.

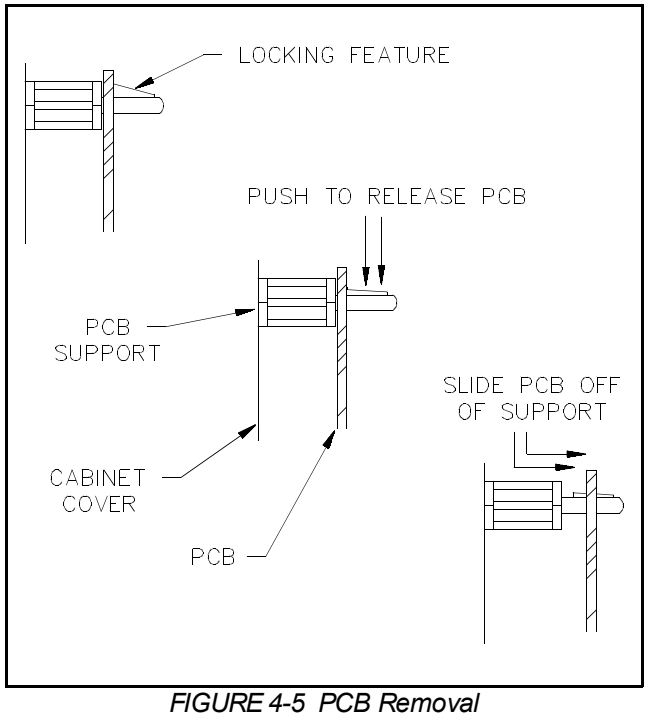


FIGURE 4-5 PCB Removal

Replacement

1. Slide the new circuit board over the supports (plug edge on top, lights facing inside manifold cover).

2. Carefully line up the circuit board lights with the cap bases protruding through the manifold cover.

3. Firmly press each corner of the circuit board until the support locking feature snaps over the board.

4. Slide the circuit board cover over the circuit board supports and press snugly at the corners.

5. Carefully insert the plug into the circuit board using one hand to stabilize the board and the other to push the plug in place.

6. Close the cabinet cover.

7. Connect electrical power to the manifold and test for proper function by following the Performance Verification procedure in Section 3.

GAUGE REPLACEMENT

Refer to Figure 4-6

Removal

1. Shutdown the manifold as explained earlier in this section.

2. Use a flat blade screwdriver and remove the six gauge plate mounting screws.

CAUTION:

- Be careful not to kink or damage the tubing connected to the gauges. Damaged tubing may burst when pressurized.

3. Pull the mounting plate up so that it provides easy access to the gauge screws on the underside of the gauge plate.

4. Mark the compression fittings per instructions on page 4-2. Using a 7/16" open end wrench, disconnect the tubing from the defective gauge. When re-tightening the fitting the procedure outlined on page 4-2 shall be followed.

5. Using a 3/8" hex wrench, remove the two screws holding the gauge brackets. Slide the gauge brackets off of the screw posts.

6. Slide the gauge out through the front of the gauge plate.

7. Using a 3/4" hex wrench, remove the compression fitting from the gauge. Use a 9/16" open end wrench to stabilize the gauge.

8. Remove the old sealant from the 1/4 NPT female pipe thread on the compression fitting.

Replacement

1. Apply Teflon® tape to the 1/4 NPT male pipe thread on the new gauge and reassemble in the reverse order of the removal procedure.

2. Make sure gauge face is properly oriented through the front of the gauge plate.

3. If the gauge needle is not on zero, unscrew the gauge bezel and adjust the needle using a flat blade screwdriver.

4. install the mounting screws to secure the gauge plate to the gauge brackets.

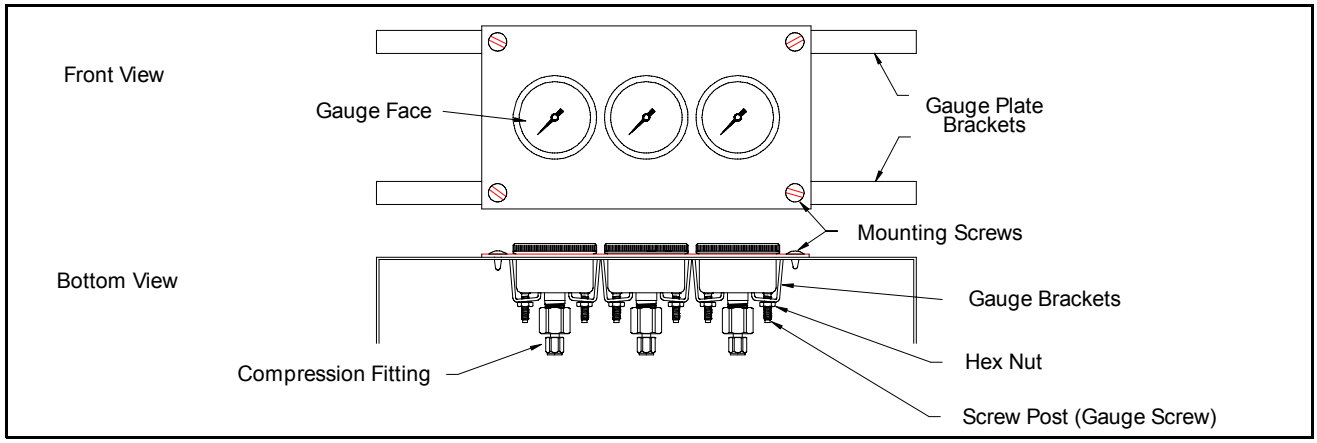


FIGURE 4-6 Gauge Plate Assembly

SOLENOID VALVE REPLACEMENT

NOTE:

- **It may be desirable to remove the gauge plate brackets prior to disassembly for easier access to the solenoid valve. It is not necessary to remove the valve from the system for repairs.**

To remove the gauge plate brackets, use a flat blade screwdriver to remove the 4 screws holding the gauges in place. The gauge plate brackets can now be removed by removing the eight mounting screws with a phillips head screwdriver.

Removal

1. Shutdown the manifold as explained earlier in this section.
2. Disconnect the electrical wires at the wire nut attachment points.
3. Mark the compression fittings per instructions on page 4-2, disconnect the tubing at the compression fittings using an 11/16" open end wrench.
4. Remove the solenoid assembly from the control section.
5. Remove the four valve bonnet screws, valve bonnet, disc holder sub-assembly, disc holder spring, diaphragm/spring sub-assembly, and body gasket. It may be necessary to bend body assembly and tubing to clear mounting bracket to ease removal of some parts.

Replacement

1. Position the solenoid assembly with the inlet end connected to the primary regulator outlet tubing.

NOTE:

- **Should diaphragm/spring sub-assembly become disassembled, be sure to replace the diaphragm/spring support with the lip facing upward towards the valve bonnet.**

2. Connect the compression fittings using an 11/16" open end wrench and tighten to effect gas tight seal. When retightening the compression fitting follow the procedure outlined on page 4-2

INTERMEDIATE PRESSURE CHECK VALVE REPAIR

Refer to Figure 4-7

Removal

1. Shutdown the manifold as explained earlier in this section.
2. Mark the compression fittings per instructions on page 4-2. Disconnect the tubing at the compression fittings to the solenoid valve and the mounting block using an 11/16" open end wrench.
3. Remove the check valve and tubing assembly from the control section.

Disassembly

1. Secure the check valve in a vice or similar holding fixture. Using a 1 1/8" hex wrench, rotate the valve cap counterclockwise and remove.
2. Remove the seal washer from the valve cap.
3. Pull the spring from the valve body.
4. Using a small needle nose pliers or tweezers, grasp the valve poppet and remove it from the valve body.
5. Clean the interior of the valve body with isopropyl alcohol or 1,1,1 trichloroethane solvent.

CAUTION

- Do not stand directly in front of the valve when performing the next step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

6. Blow out the check valve body with oil free Air or Nitrogen to remove all foreign material and dry all surfaces.

Reassembly

1. Insert a new valve poppet into the valve body.
2. Insert the spring into the valve body.
3. Position the new seal washer in the groove of the valve body.
4. Place the valve cap over the spring and push the cap towards the body until the threads engage. Rotate the cap clockwise and tighten securely.

Replacement

1. Position the check valve and tube assembly in the control section with the check valve flow arrow pointing away from the solenoid valve.
2. Connect the compression fittings to the solenoid valve and the mounting block following the instructions on page 4-2 using an 11/16" open end wrench and tighten to effect a gastight seal.

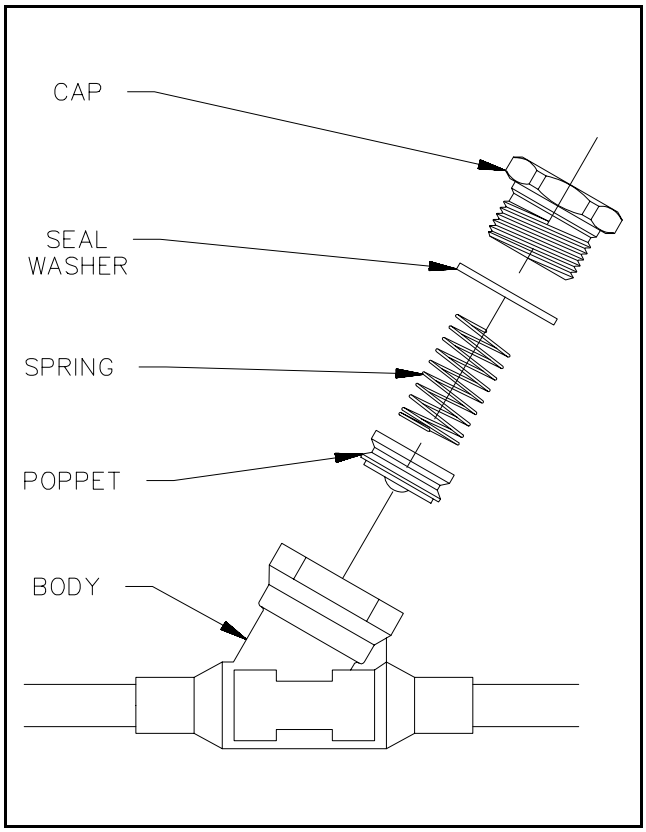


FIGURE 4-7 Intermediate Check Valve

PRIMARY REGULATOR REPAIR

NOTE:

- Removal and Replacement procedures are to be followed only if the primary regulator assembly is to be scrapped. All service may be performed to the primary regulator without removing it from the manifold.

Refer to Figures 4-8 and 4-9

Shutdown the manifold as explained earlier in this section.

Removal

1. Mark the compression fittings per instructions on page 4-2. Using an 11/16" open end wrench, disconnect the outlet tubing and the relief valve tubing from the regulator at the compression fittings.
2. Mark the compression fittings per instructions on page 4-2. Using a 7/16" open end wrench, disconnect the gauge tubing and pressure switch tubing from the regulator at the compression fittings.
3. Using two 1 1/8" open end wrenches, loosen the inlet nut from the mounting block adaptor. Continue to unscrew the nut by hand until the regulator can be removed from the manifold.

Disassembly

1. Remove the acorn nut from the regulator by turning it counterclockwise using a 3/4" hex wrench.
2. Using a flat blade screwdriver held sideways, turn the adjusting screw counterclockwise until it turns freely and all compression is removed from the bonnet spring.
3. Using a 1 3/8" hex wrench, rotate the bonnet counterclockwise and remove it along with the pivot, bonnet spring, washer, slip ring, and diaphragm sub-assembly.
4. Using a 13/16" hex socket wrench, rotate the nozzle counterclockwise and remove it along with the seat holder and stem, compensating spring, and the spring retainer. In oxygen manifolds these parts are contained in a cartridge valve assembly.

CAUTION:

- Do not stand directly in front of the valve when performing this step. Eye protection should be worn to protect the service technician. Chips and/or debris may be propelled into unprotected eyes.

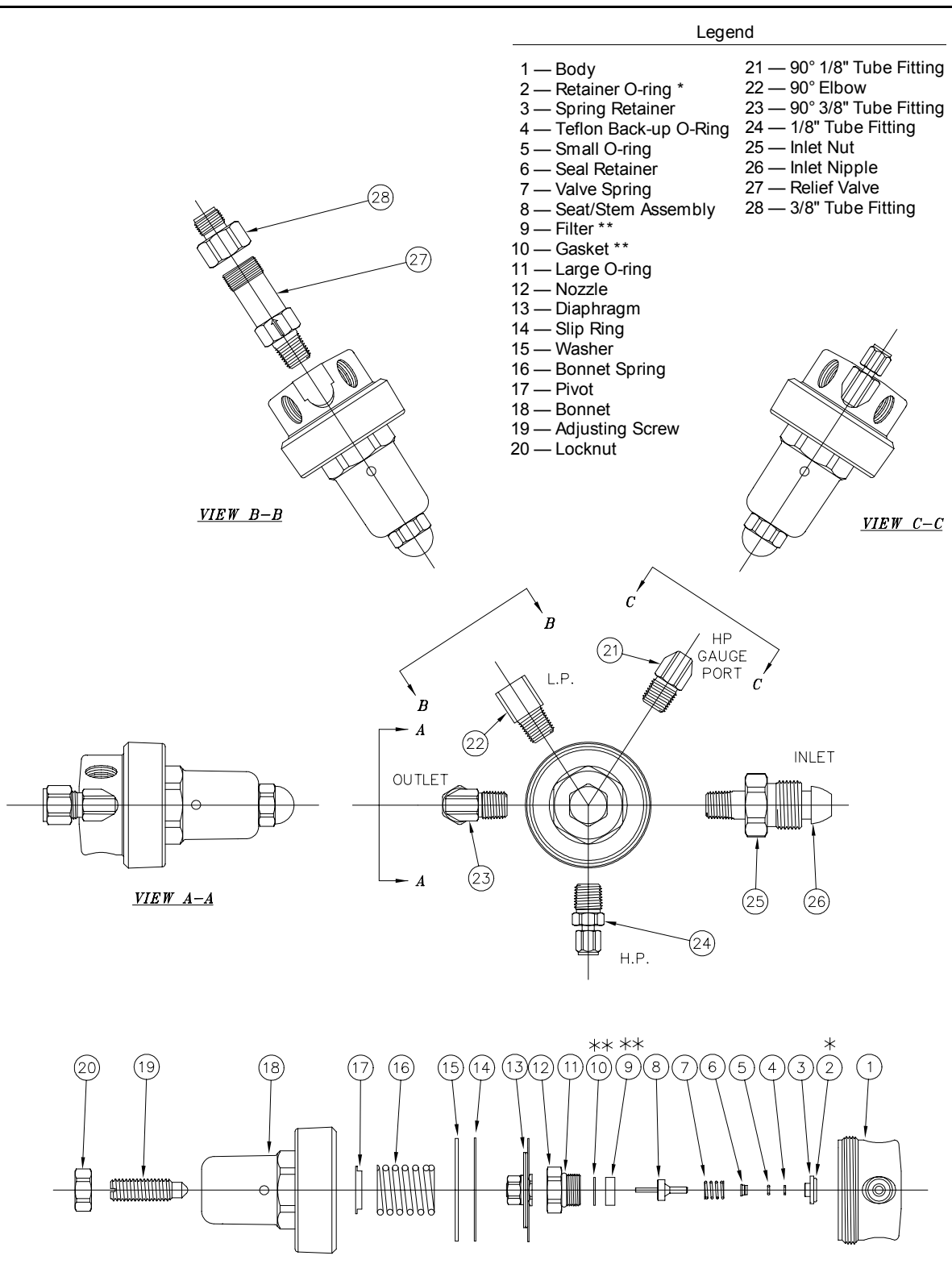
5. Clean all interior surfaces of the regulator body with isopropyl alcohol.
6. Blow out the regulator body and ports with oil free Air or Nitrogen to remove all foreign materials and dry all surfaces.

Reassembly

1. Apply a thin coating of Fluorolube® S-30 lubricant to the o-rings.

Note: steps 2—6 are not applicable to Oxygen regulator cartridge valve assemblies.

2. Assemble small o-rings with the spring retainer. Push the smaller o-ring to the bottom of the bore it rests in.
3. Assemble the large o-ring with the nozzle.
4. Insert the new seat holder and stem into the nozzle. The silver colored end of the seat holder and stem must enter the nozzle first.
5. Place the compensating spring over the seat holder and stem.



* This O-Ring is not used on manifolds with S/N 20800 and greater.
** Some regulators do not include this filter or gasket. When installing a repair kit, the filter and gasket should be installed.

FIGURE 4-8 Primary Regulator - Except Oxygen S/N up to 11348

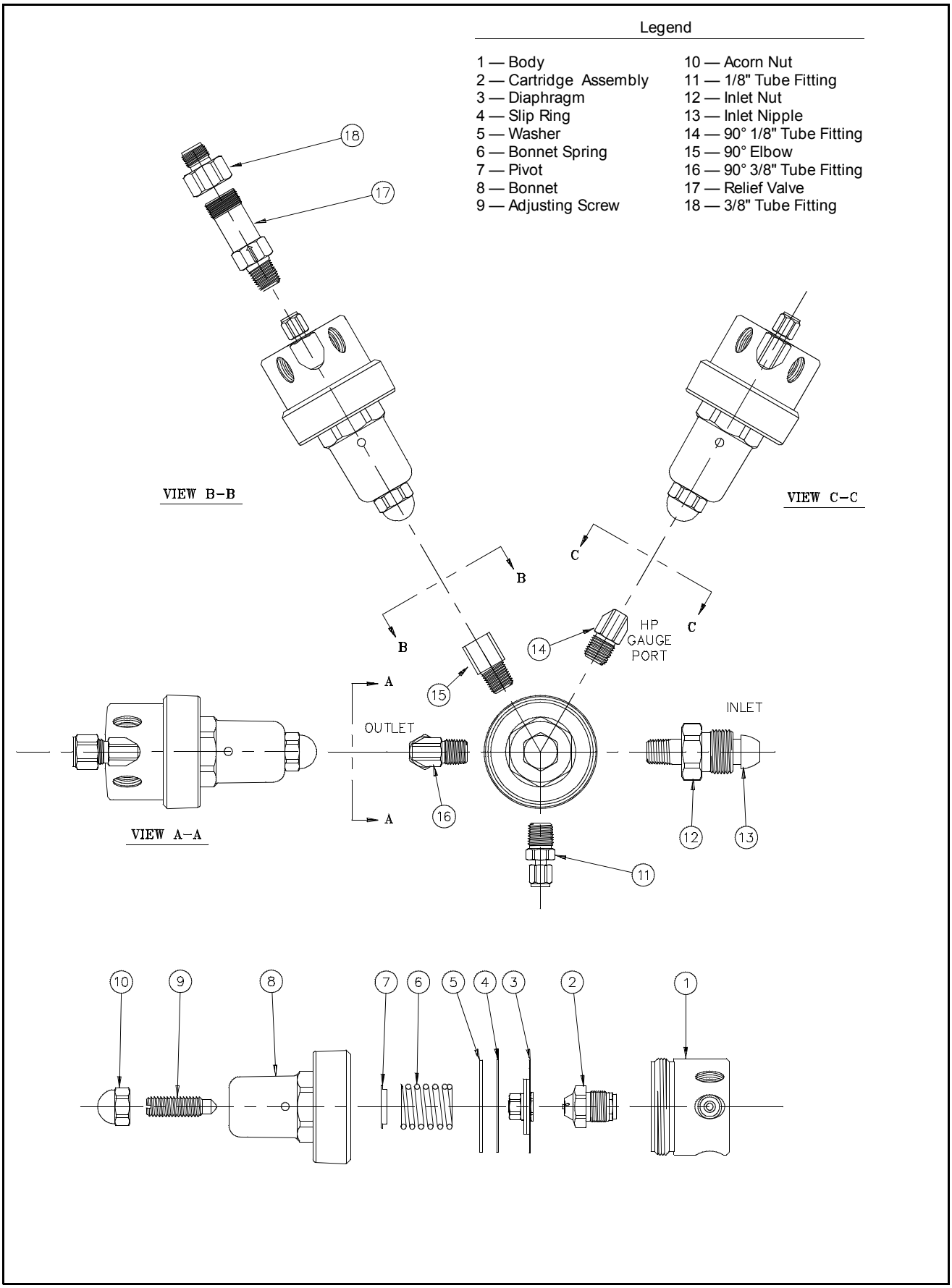


FIGURE 4-9 Primary Regulator - Oxygen S/N up to 11348

6. Place the compensating spring retainer on the compensating spring. The boss on the retainer will enter the internal diameter of the spring and the larger o-ring will now be on top.
7. Grasp the flats of the nozzle with one hand and carefully guide the seat/nozzle assembly into the body of the regulator until the threads are engaged. Rotate the nozzle clockwise and hand tighten.
8. Using the 13/16" hex socket and torque wrench, tighten the nozzle to approximately 5 ft-lbs. torque.
9. Lubricate the outer (regulator body to diaphragm) sealing surface of the regulator body with a small amount of water. Do not allow water to enter the low pressure chamber of the regulator.
10. Hold the bonnet upside down and place the pivot and bonnet spring in the bore provided. The small diameter of the pivot should enter the internal diameter of the spring.
11. Place the washer in the large bonnet cavity, beveled side up.
12. Lay the slip ring on top of the washer.
13. Insert the diaphragm sub-assembly in the bonnet cavity. The side marked "UP" should be against the slip ring.
14. Carefully place the bonnet on the regulator body. Rotate the bonnet clockwise and tighten to 50-60 ft-lbs. torque.

Replacement

1. Connect the regulator inlet to the regulator port on the mounting block and assemble hand tight. Orient the regulator so the bonnet is facing towards the ground with the manifold mounted on a wall. Using two 1 1/8" open end wrenches, tighten the inlet nut/mounting block adaptor connection to effect a gas tight seal.
2. Using a 7/16" open end wrench, connect the pressure switch tubing to the 1/8" tube compression fitting located 90° from the inlet of the regulator. With the regulator installed and facing towards the ground, it is the fitting on the left side.
3. Connect the gauge tubing to the other 1/8" tube compression fitting on the regulator per tightening instructions on page 4-2.
4. Using an 11/16" open end wrench, connect the outlet tubing to the 3/8" tube compression fitting located 180° from the inlet of the regulator per tightening instructions on page 4-2..
5. Connect the relief valve tubing to the 3/8" tube compression fitting on the relief valve of the regulator per tightening instructions on page 4-2..

Primary Regulator Adjustment

1. If not already done, shutdown the manifold as explained earlier in this section, open the manifold cover, and remove the acorn nut from the primary regulator.
2. S-l-o-w-l-y open one cylinder on the side of the regulator to be adjusted.
3. Verify the cylinder pressure gauge indicates a minimum pressure of 1400 psig on Oxygen, Air, and Nitrogen systems or a minimum of 600 psig on Nitrous Oxide and Carbon Dioxide systems.
4. Using a flat blade screwdriver held sideways, turn the adjusting screw of the regulator in while observing the intermediate pressure gauge. Set the regulator to the pressure indicated on the Adjustment Specification chart in Section 1.
5. Open the bleed valve so as to create a slight flow of gas through the manifold.
6. Re-adjust the regulator to the proper specifications if necessary.

7. Close the bleed valve. The intermediate pressure gauge will go up slightly higher than the flowing adjusted pressure.
8. Verify that the regulator does not creep by observing the intermediate pressure gauge for two minutes. The gauge must indicate the same pressure at the end of the two minute period.
9. Close the cylinder valve.
10. Open the bleed valve to remove residual gas from the manifold.

11. Close the bleed valve after the gas pressure has been exhausted from the manifold.

12. Install the lock nut on the primary regulator.

LINE REGULATOR REPAIR

Refer to Figures 4-10 and 4-11

Removal

1. Turn the three way bypass valve to feed the reserve line regulator. The manifold does not have to be shut down.

2. Mark the compression fittings per instructions on page 4-2. Use a 11/16" open end wrench to loosen the nuts.

3. Carefully remove the line regulator from the manifold.

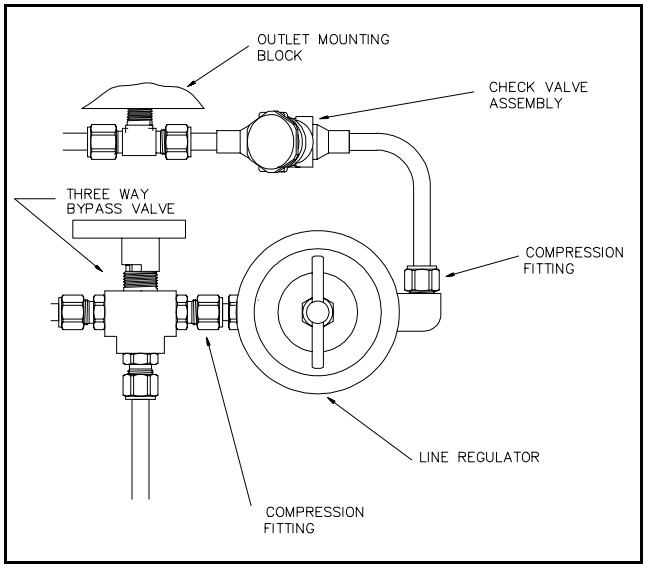


FIGURE 4-10 Line Regulator Assembly

Disassembly

1. Place the regulator in a vise or similar holding fixture.

2. Using an 11/16" open end wrench, loosen the locknut on the regulator adjusting screw and back off the adjusting screw until it turns freely and all compression is removed from the bonnet spring.

3. Using a 1 1/2" hex wrench, remove the backcap and conical spring from the regulator.

4. Remove the gasket from the backcap and discard.

5. Use a phillips head screwdriver to remove the six screws attaching the bonnet to the body. Lift the bonnet off of the body and set aside the bonnet, pivot, bonnet spring, and screws.

6. The diaphragm assembly and the seat/stem assembly are attached at each end of the stainless steel rod. The stainless steel rod is threaded on both ends. Using a 5/8" hex wrench to stabilize the diaphragm assembly, reach under the regulator with a 1/4" open end wrench, placing it over the wrench flats provided on the bottom of the seat assembly, and loosen the seat assembly. The seat can be unscrewed by hand after loosening. Remove and discard the diaphragm and seat assemblies.

Reassembly

1. Set the new diaphragm assembly on the body with the spring retainer facing up.

2. Insert the new stem/seat assembly through the backcap port and screw into the diaphragm assembly by hand. Stabilize the diaphragm assembly using one hand and snug up the seat/stem assembly with the other hand using a 1/4" open end wrench. Do not over tighten.

3. Place the new gasket in the backcap groove.

4. Place the conical spring, large end first, into the backcap cavity.

5. Carefully line up the spring small end so that it slides over the wrench flats on the seat/stem assembly and screw the backcap into position. Tighten with a 1 1/2" hex wrench.

6. Line up the diaphragm holes with the screw holes in the body.
7. Set the bonnet spring in the retainer on the diaphragm assembly.
8. Set the pivot on top of the spring, pointed end down.
9. Set the bonnet carefully over the spring and pivot and line up the screw holes in the bonnet with the screw holes in the body.
10. Insert the six screws in the screw holes and tighten by hand. Use a phillips head screwdriver and tighten the screws in a crisscross manner.
11. Remove the regulator from the vice.

Replacement

1. Install the regulator in the manifold.
2. Tighten the inlet and outlet union connections per the instructions on page 4-2.Use a 11/16" open end wrench to snug up the connections per instructions on page 4-2.
3. Leak test all of the line regulator connections and the connections on the check valve.

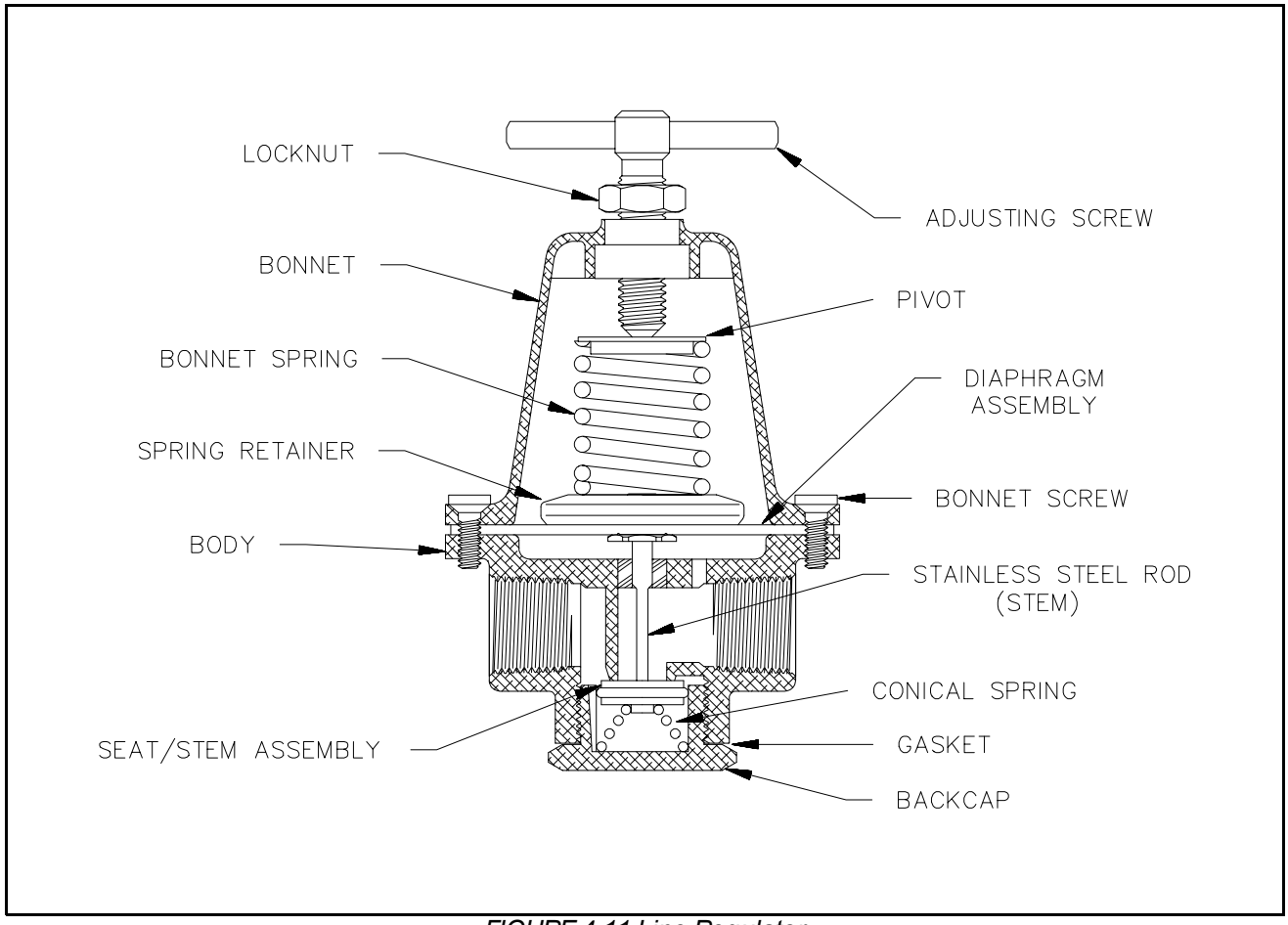


FIGURE 4-11 Line Regulator

MAINTENANCE & REPAIR PARTS

NOTE:
- Western manifold systems are designed and tested for optimal performance and adherence to safety specifications. We recommend the use of Western replacement components to maintain the standards of performance and the safety of the product.

REPLACEMENT PIGTAILS

24" Stainless Steel Flexible Braid with Check Valves

PF-320CV-24R.....CGA 320 for Carbon Dioxide (CO_2) Service
PF-326CV-24R.....CGA 326 for Nitrous Oxide (N_2O) Service
PF-346CV-24R.....CGA 346 for Breathing Air (Air) Service
PF-63CV-24 .....CGA 540 for Oxygen (O_2) Service
PF-92CV-24R.....CGA 580 for Nitrogen (N_2) Service
PF-280CV-24 .....CGA 280 for Medical Mixtures

24" Synthetic Fiber Braid Hose with Check Valve

PFS-92CV-24R .....CGA 580 for Helium (He) Service

INDICATOR LAMP REPLACEMENT PARTS (for Nitrous Oxide or Carbon Dioxide Heater)

WME-8-5.....Bulb Receptacle
WME-8-8.....Amber Lens
WME-8-10.....115 V Light Bulb

PANEL MOUNT GAUGES — 2" Diameter, 1/4" NPT Back Port

WMG-3-3 .....100 psi
WMG-3-4 .....400 psi
WMG-3-8 .....2000 psi
WMG-3-12 .....4000 psi

INTERMEDIATE BOTTOM MOUNT GAUGES — 1.5" Diameter, 1/8" NPT Bottom Port

G-15-400.....400 psi

REGULATORS AND REGULATOR REPAIR KITS

8534* .....Primary Regulator for HQ2 & HQ2HL- (N_2O, CO_2, Breathing Air,He) S/N up to 20799
8534A.....Primary Regulator for HQ2 (Breathing Air, He) S/N 20800 and greater
8534B .....Primary Regulator for HQ2HL (CO_2 & N_2O) S/N 20800 and greater
8532* .....Primary Regulator for HQ2HP-(N_2) S/N up to 20799
8532A.....Primary Regulator HQ2HP (N_2) S/N 20800 and greater
8530A* .....Primary Regulator for HQ2-9, HQ2-12 & HQ2-13 S/N up to 11348
8538* .....Primary Regulator for HQ2-9, HQ2-12 & HQ2-13 S/N greater than 11348, up to 20799
8538A.....Primary Regulator for HQ2 (Oxygen) S/N 20800 and greater
8430 .....Line Regulator - (HQ2HP All Gases)
8431 .....Line Regulator (HQ2 & HQ2HL All Gases)
RK-1020 .....Repair Kit for # 8534 & # 8532 - (N_2O, CO_2, He, Air, N_2)
RK-1100 .....Repair Kit for # 8430 & 8431 - All gases (Shipped prior to 6/1/95)
RK-1100M.....Repair Kit for 8430 & 8431 - All gases (Shipped after 6/1/95)
RK-1023 .....Repair Kit for # 8430A - (O_2 and Medical Breathing Mixtures)
RK-1033 .....Repair Kit for 8538
RK-1037 .....Repair kit for # 8534A, 8534B, and 8532A (N_2O, CO_2, Air, He, N_2)
RK-1038 .....Repair kit for # 8538A (Oxygen)

* Replacement regulator not available. Use repair kit or request upgrade to latest version. If updating the regulators to the latest configuration both regulators and solenoid bypass check valves (P/N WMV-5-15 for Air, CO_2, N_2O, He and P/N WMS-1-134 for oxygen) must be replaced.

VALVES AND VALVE REPAIR KITS

8423 .....Solenoid Valve for all HQ2 and HQ2HP - (Breathing Air, He, N_2, O_2)
8422 .....Solenoid Valve for all HQ2HL - (N_2O and CO_2 manifolds)
WMS-1-53 .....CGA 540 Spud Check Valve
WMS-1-64 .....CGA 280 Spud Check Valve
WMV-2-7 .....CGA 320 Header Valve
WMV-2-4 .....CGA 346 Header Valve
WMV-2-14 .....CGA 326 Header Valve
WMV-2-3 .....CGA 580 Header Valve
WMV-2-54 .....Three Way Bypass Valve
WMV-2-16 .....Master Valve
WMV-5-15 .....Solenoid Bypass Check Valve
RK-1085 .....Repair Kit for # WMV-2-16

PRESSURE SWITCHES

8413 .....High Pressure Switch for all series
WME-4-4 .....Low Pressure Switch (adjustable 0-300 psi)
WME-4-4C.....Low Pressure Switch (Oxygen)

POWER SUPPLY REPLACEMENT PARTS

8450 .....Manifold Controller PCB
8570D.....Power Supply Assembly (transformer, PCB, case, and cable)
WME-8-1 .....Power Supply PCB (includes dry contacts for remote alarms)

REMOTE ALARMS — 24 VAC Service

BIA-1 .....Visual - 1 Gas
BIA-2 .....Audio/Visual - 2 Gases
BIA-3 .....Audio/Visual - 1 Gas

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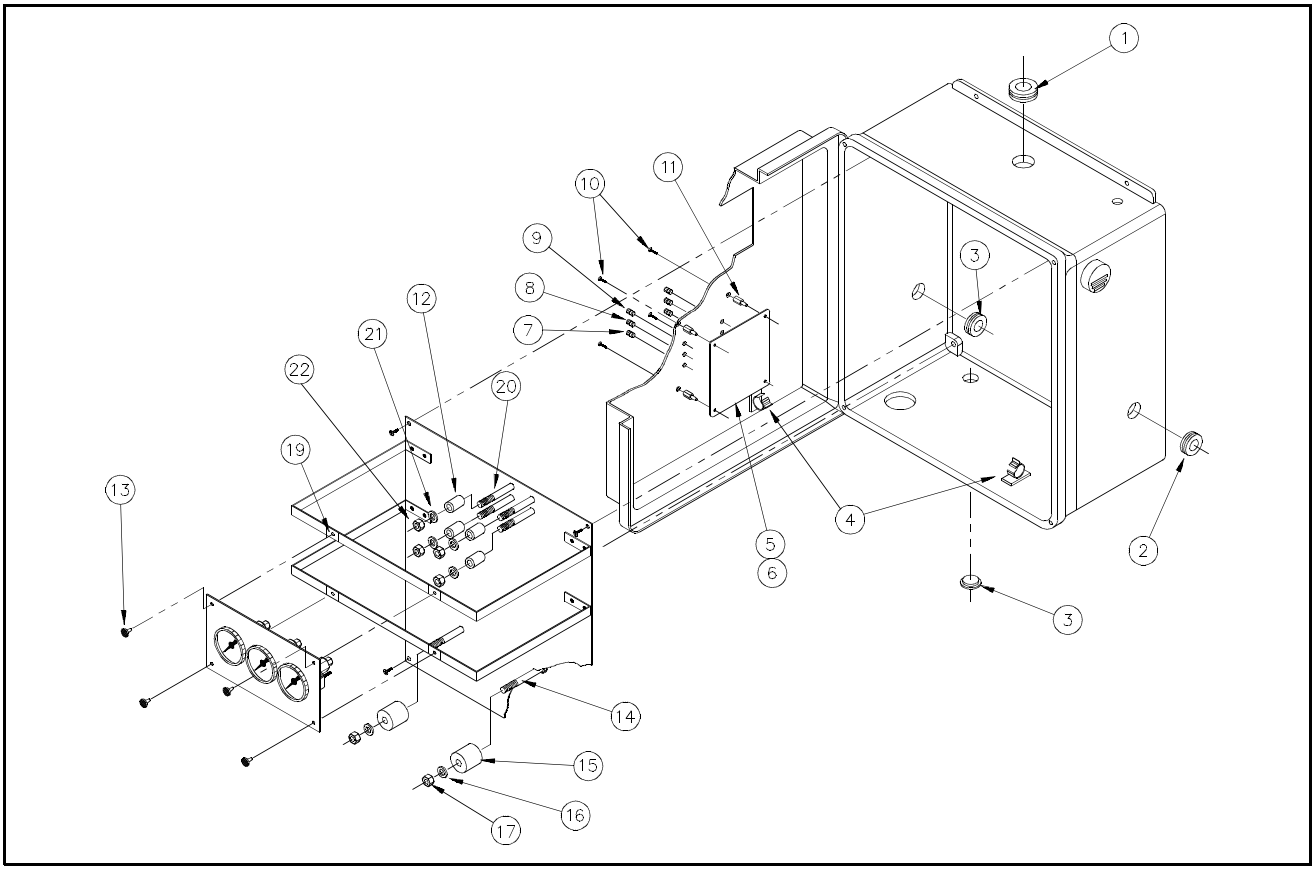
INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2 & HQ2HP Series

Repair Drawing

Miscellaneous Hardware



KEY #	DESCRIPTION	PART #
1	Outlet Grommet	8281
2	Inlet Grommet	8280
3	Plug	8282
4	Wire Clip	8242
5	Printed Circuit Board	8450
6	PCB Cover	8246
7	Red Lens	8243
8	Yellow Lens	8244
9	Green Lens	8245
10	# 6-32 Self-Tapping Screw	WMC-2-29
11	PCB Support 1/2"	8240
12	Outlet Block Spacer	WLF-6-66

KEY #	DESCRIPTION	PART #
13	Mounting Screw	WMC-6-49
14	3/8-16 x 3" Bolt	8170
15	Block Spacer	8151
16	3/8" Lock Washer	8171
17	3/8-16 Hex Nut	WMC-6-6
18	Wiring Harness	8571
19	Screw Receptacle	WMC-6-35
20	3/16-32 X 3" Bolt	EQ-106
21	3/16 Lock Washer	WMC-6-12
22	3/16-32 Hex nut	WMC-6-8
*	Wire Nut	WME-8-58

* Item not pictured.

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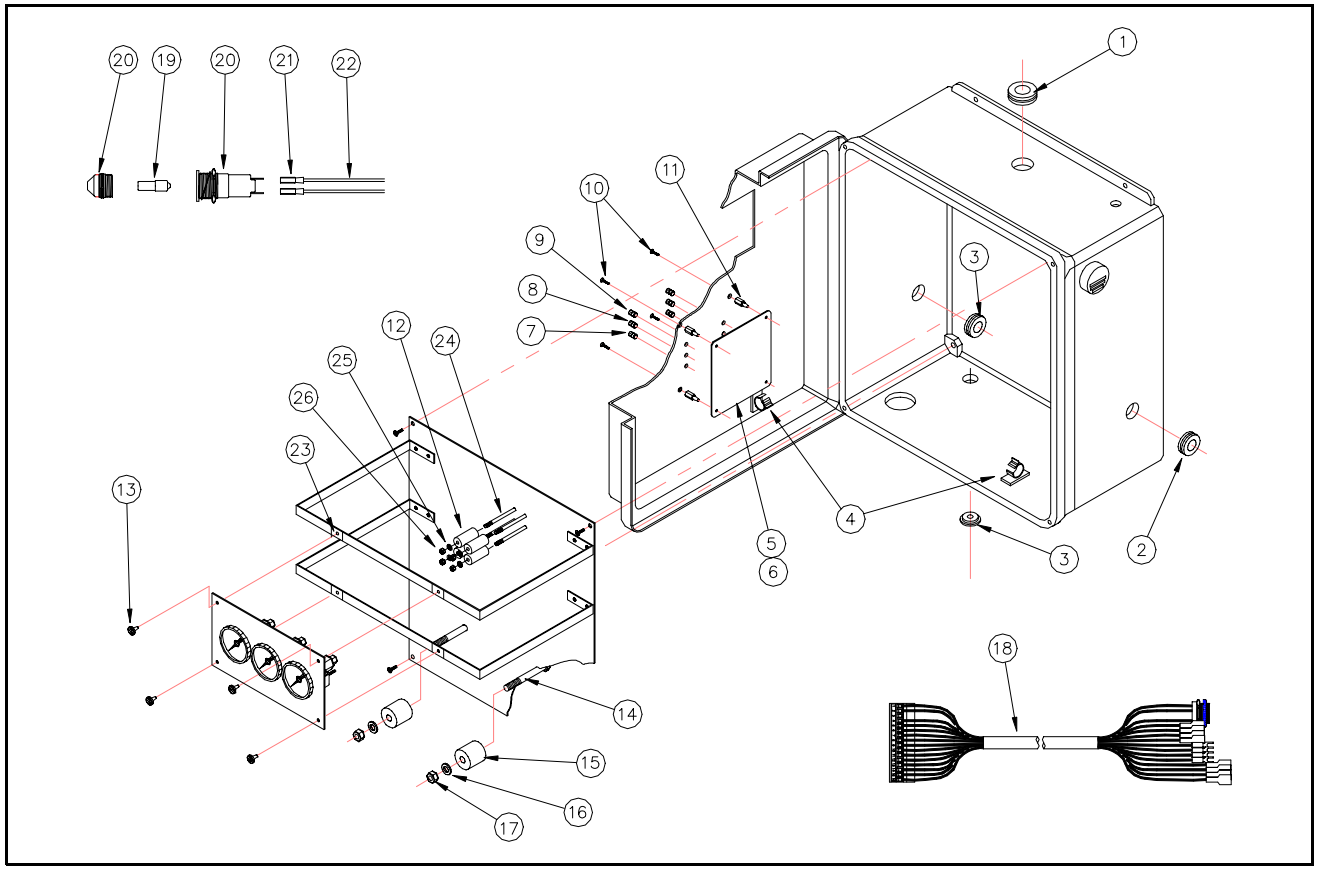
Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2HL Series

Miscellaneous Hardware



KEY #	DESCRIPTION	PART #
1	Outlet Grommet	8281
2	Inlet Grommet	8280
3	Strain Relief Bushing	WME-8-34
4	Wire Clip	8242
5	Printed Circuit Board	8450
6	PCB Cover	8246
7	Red Lens	8243
8	Yellow Lens	8244
9	Green Lens	8245
10	# 6-32 Self-Tapping Screw	WMC-2-29
11	PCB Support 1/2"	8240
12	Outlet Block Spacer	WLF-6-66
13	Mounting Screw	WMC-6-49
14	3/8-16 x 3" Bolt	8170
15	Block Spacer	8151

KEY #	DESCRIPTION	PART #
16	3/8" Lock Washer	8171
17	3/8-16 Hex Nut	WMC-6-6
18	Wiring Harness	8571
19	115 Volt Bulb	WME-8-10
20	Indicator Receptacle & Lens	WME-8-72
21	Wire Terminal	WME-8-77
22	16 Gage Wire 16"	WME-8-57
23	Screw Receptacle	WMC-6-35
24	3/16-32 X 3" Bolt	EQ-106
25	3/16 Lock Washer	WMC-6-12
26	3/16-32 Hex nut	WMC-6-8
*	7' Heater Cord	WME-8-33
*	Wire Nut	WME-8-58

* Item not pictured.

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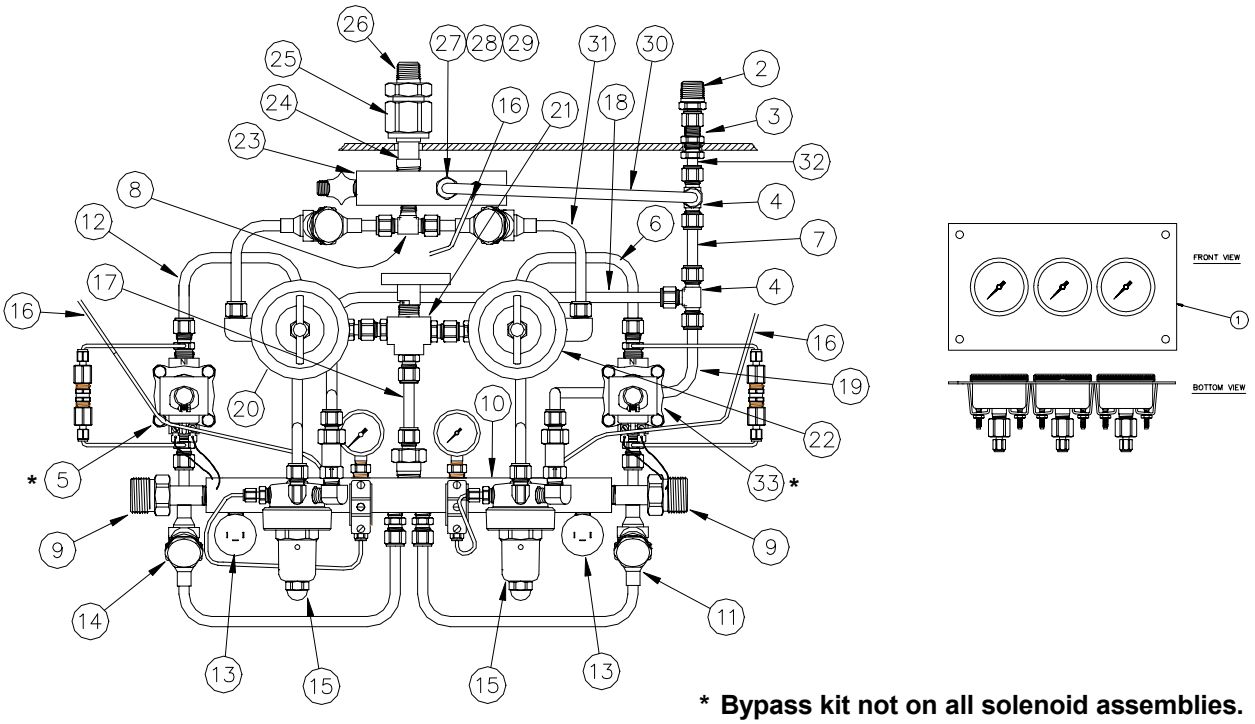
INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2 & HQ2HP Series

Repair Drawing

Manifold Components



*** Bypass kit not on all solenoid assemblies.**

KEY #	DESCRIPTION	PART #
1	Gauge Plate Assembly	
	for HQ2 & HQ2-9 Series	8540
	for HQ2HP Series	8541
2	Relief Piping Adaptor	WLF-3-12
3	3/8" Tube Bulkhead	WLF-3-13
4	3/8" Tube Tee	WLF-3-14
5	Left Solenoid Valve Assem	8551L
6	3/8" Tubing Reg-Right Sol	WLF-6-63
7	3/8" Tubing Relief Tee-Tee	WLF-6-60
8	3/8" Tubing Tee-Outlet	WLF-3-18
9	Inlet Adaptor	WMS-1-44
10	Mounting Block Assembly	WMS-1-32
11	Check Valve Right Side	8584
12	3/8" Tubing Reg-Left Sol	WLF-6-65
13	High Pressure Switch	8413
14	Check Valve Left Side	8583
15	Primary Regulator	
	for HQ2 Series	See page 5-1
	for HQ2HP Series	See page 5-1
	for HQ2-9 (oxygen) Series	See page 5-1
16	1/8" x 12" Tubing	WLF-6-18
17	Block-3 way 3/8" tubing	WLF-6-61

KEY #	DESCRIPTION	PART #
18	3/8" Tubing L. Relief-Tee	WLF-6-64
19	3/8" Tubing R. Relief-Tee	WLF-6-62
20	Left Line Regulator Assy	
	for HQ2HP Series	8561
	for HQ2 Series	8563
21	Three Way Valve	WMV-2-54
22	Right Line Regulator Assy	
	for HQ2HP Series	8562
	for HQ2 Series	8564
23	Outlet Block	WMC-2-26
24	Outlet Nipple	D-20
25	Outlet Hex Nut	D-7
26	Outlet Adaptor	D-34
27	Line Relief Valve	
	for HQ2 & HQ2-9 Series	WMV-8-75
	for HQHP Series	WMV-8-250
28	Pipe Away Adaptor	WMV-8-7
29	3/8" Tube x 1/2 NPT Male	WLF-3-15
30	3/8" Tubing Line Relief-Tee	8341
31	LineReg-Tee CV assembly	8582
32	3/8" Tubing Tee-Bulkhead	8321
33	Right Solenoid Valve Assem	8551R

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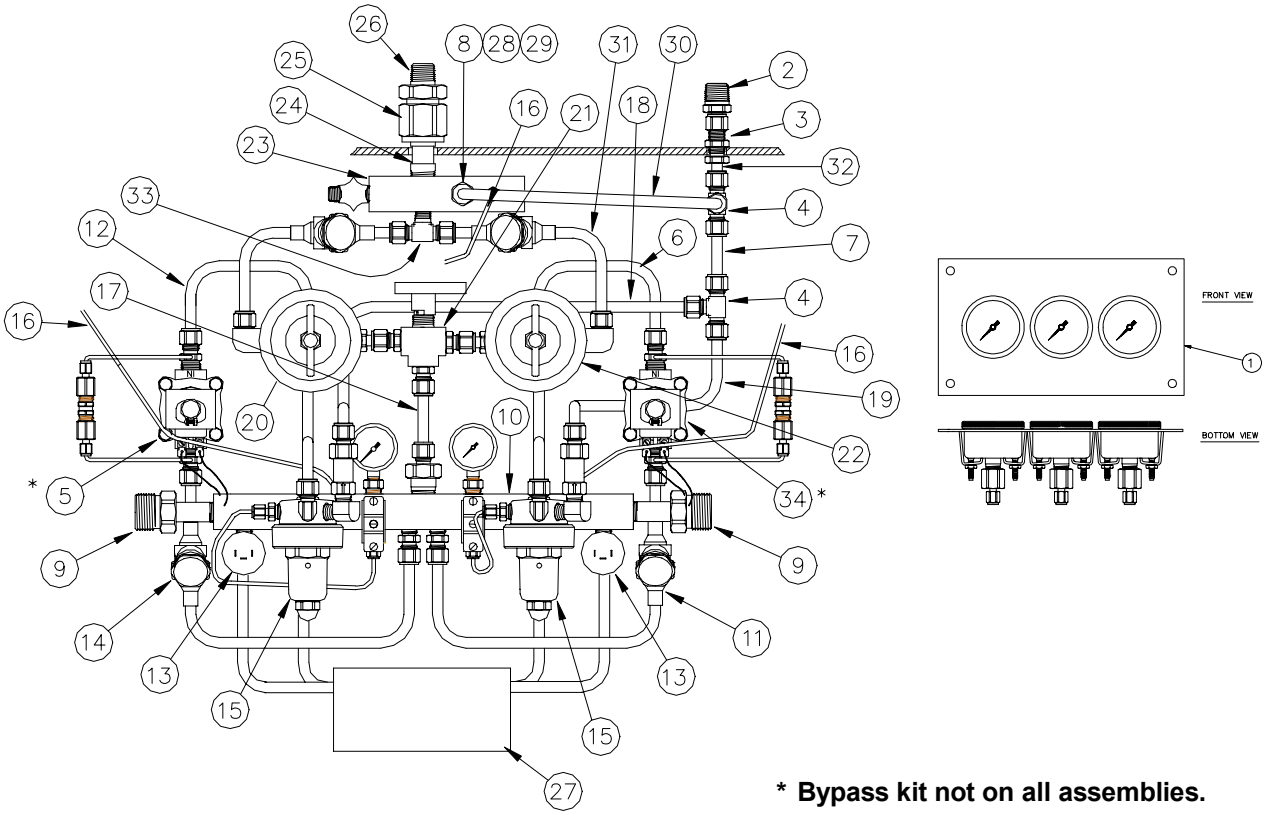
AUTOMATIC CHANGEOVER MANIFOLD
HQ2HL Series

Repair Drawing

Manifold Components



*** Bypass kit not on all assemblies.**

KEY #	DESCRIPTION	PART #
1	Gauge Plate Assembly	8542
2	Relief Piping Adaptor	WLF-3-12
3	3/8" Tube Bulkhead	WLF-3-13
4	3/8" Tube Tee	WLF-3-14
5	Left Solenoid Valve Assem	8552L
6	3/8" Tubing Right Reg-Sol	WLF-6-63
7	3/8" Tubing Relief Tee-Tee	WLF-6-60
8	Pipe away adaptor	WMV-8-7
9	Inlet Adaptor	WMS-1-44
10	Mounting Block Assembly	WMS-1-32
11	Check Valve Right Side	8584
12	3/8" Tubing Left Reg-Sol	WLF-6-65
13	High Pressure Switch	8413
14	Check Valve Left Side	8583
15	Primary Regulator	8534
16	1/8" x 12" Tubing	WLF-6-18
17	Block - 3 way tubing	WLF-6-61
18	3/8" Tubing L. Relief-Tee	WLF-6-64

KEY #	DESCRIPTION	PART #
19	3/8" Tubing R. Relief-Tee	WLF-6-62
20	Left Line Regulator Assy	8563
21	Three Way Valve	WMV-2-54
22	Right Line Regulator Assy	8564
23	Outlet Block Assembly	WMC-2-26
24	Outlet Nipple	D-20
25	Outlet Hex Nut	D-7
26	Outlet Adaptor	D-34
27	Heater Assembly	8590
28	Line Relief Valve	
	HQ2HL-4 Series	WMV-8-75
	HQ2HL-8 Series	WMV-8-60
29	3/8" Tube x 1/2 NPT Male	WLF-3-15
30	3/8" Tubing Line Relief-Tee	8341
31	Line Reg-Tee CV Assy	8582
32	3/8" Tubing Tee-Bulkhead	8321
33	3/8" Tubing Tee-Outlet	WLF-3-18
34	Right Solenoid Valve Assem.	8552R

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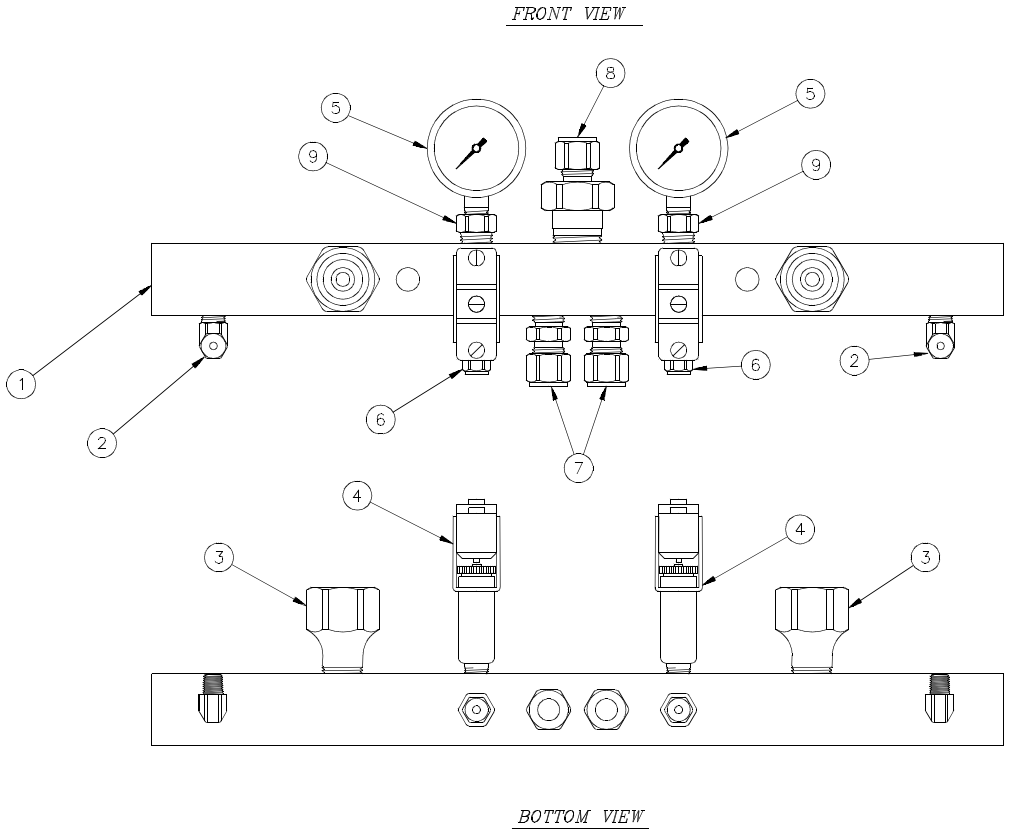
INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2 and HQ2HP Series

Repair Drawing

Mounting Block Components



KEY #	DESCRIPTION	PART #
1	Mounting Block	8112
2	1/4" Street Elbow	BL-4HP
3	Adaptor for Primary Regulator	B-71
4	Low Pressure Switch	WME-4-4
5	Intermediate Gauge, 400 psi	G-15-400
6	1/8" Tube x 1/4 NPT Male	WLF-3-8
7	3/8" Tube x 1/4 NPT Male	WLF-3-5
8	3/8" Tube x 1/2 NPT Male	WLF-3-15
9	1/8" NPT to 1/4" NPT Bushing	BB-2-4HP

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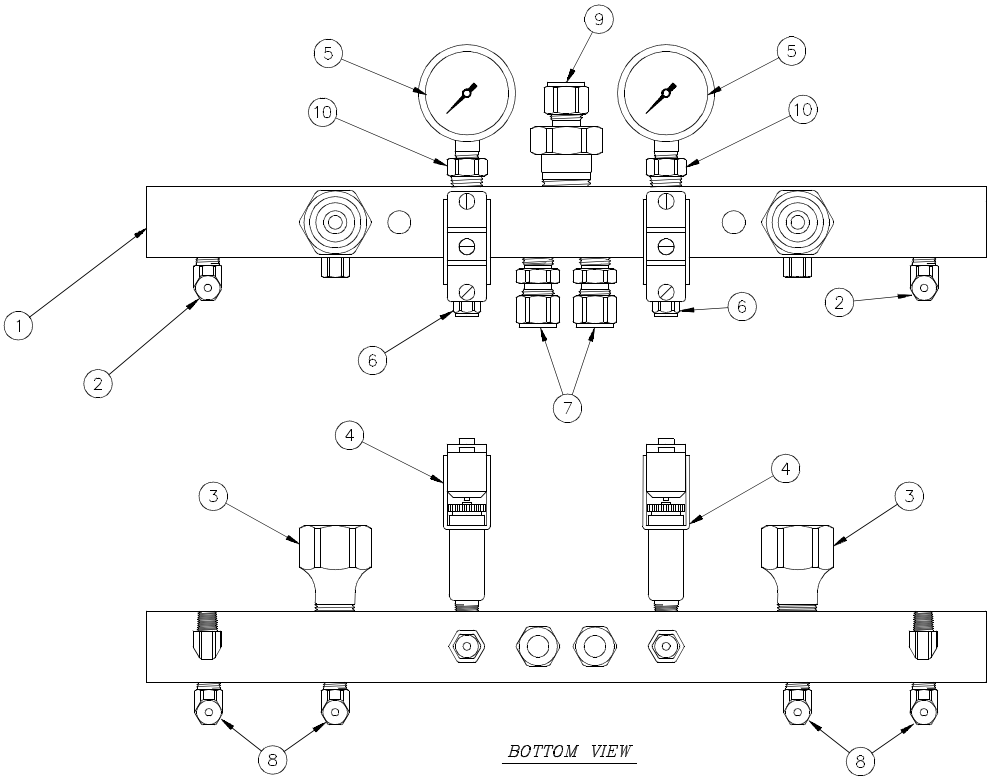
INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2HL Series

Repair Drawing

Mounting Block Components

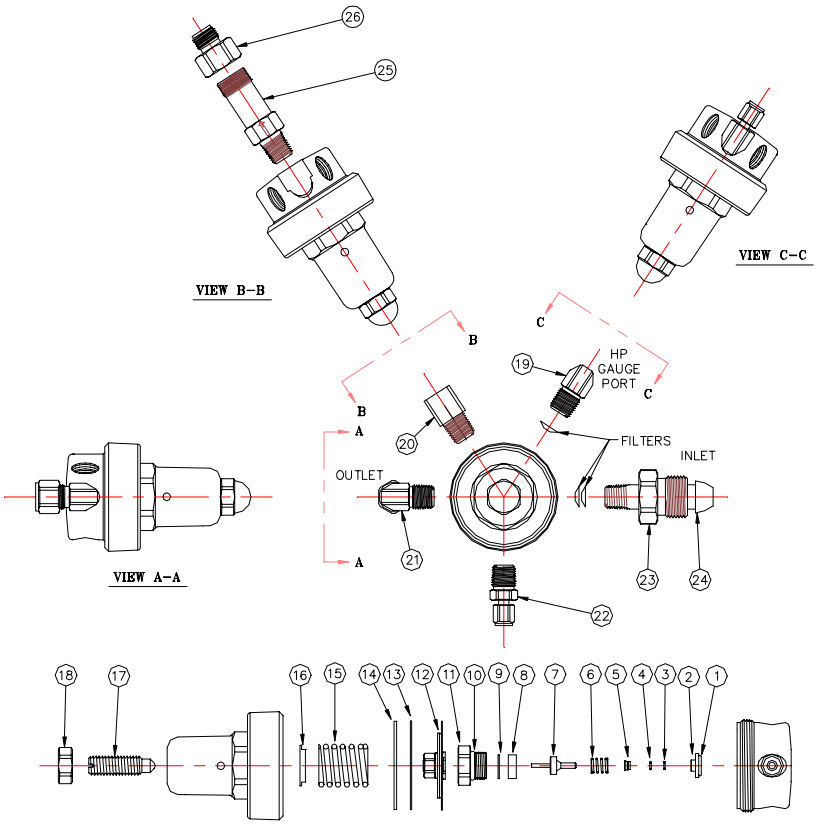


KEY #	DESCRIPTION	PART #
1	Mounting Block	8113
2	1/8" Tube x 1/8 NPT Male	BL-4HP
3	Adaptor for Primary Regulator	B-71
4	Low Pressure Switch	WME-4-4
5	Intermediate Gauge, 400 psi	G-15-400
6	1/8" Tube x 1/4 NPT Male	WLF-3-8
7	3/8" Tube x 1/4 NPT Male	WLF-3-5
8	1/4" Tube x 1/8 NPT Male 90°	WLF-3-3
9	3/8" Tube x 1/2 NPT Male	WLF-3-15
10	1/8" NPT to 1/4" NPT Bushing	BB-2-4HP

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2, HQ2HL, and HQ2HP Series
and HQ2-9 Series S/N greater than 11348
Primary Regulator Components



KEY #		DESCRIPTION	PART #
1*	**	Retainer O-Ring	RO-012E
2*		Spring Retainer	RWS-3-15
3*		Backup Ring	RWS-5-7
4*		Small O-Ring	RWS-3-47
5*		Seal Retainer	RWS-6-4
6*		Body Spring	
		for HQ2-9 Series	RWS-1-17
		for all others	RWS-1-8
7*		Seat/Stem Assembly	
		for HQ2 & HQ2HP Series	RWS-3-6
		for HQ2HL Series	RWS-3-6
		for HQ2-9 Series	RWS-6-3
8*		Filter	S-5
9*		Gasket	RWS-3-70
10*		Large O-Ring	RO-015E
11*		Nozzle	
		for HQ2-9 Series	RWS-5-1
		for all others	RWS-3-18
12*		Diaphragm Assembly	RWS-3-26
13*		Slip Ring	RWS-3-17

KEY #	DESCRIPTION	PART #
14*	Washer	RWS-3-28
15	Bonnet Spring	RWS-7-54
16	Pivot	RWC-2-8P
17	Adjusting Screw	RWS-3-3
18	Lock Nut	WMC-6-90
19	1/8" Tube x 1/4 NPT 90°	WLF-3-7
20	1/4 NPT Elbow M x F	BL-4-4LP
21	3/8" Tube x 1/4 NPT 90°	WLF-3-6
22	1/8" Tube x 1/4 NPT Male	WLF-3-8
23	Inlet Nut	92
24	Inlet Nipple	15-8
25	Safety Relief Valve	
	for HQ2 & HQ2HL Series	8531
	for HQ2HP Series	8533
26	Relief Valve Adaptor	8131

* Items included in repair kits (See page 5-1)

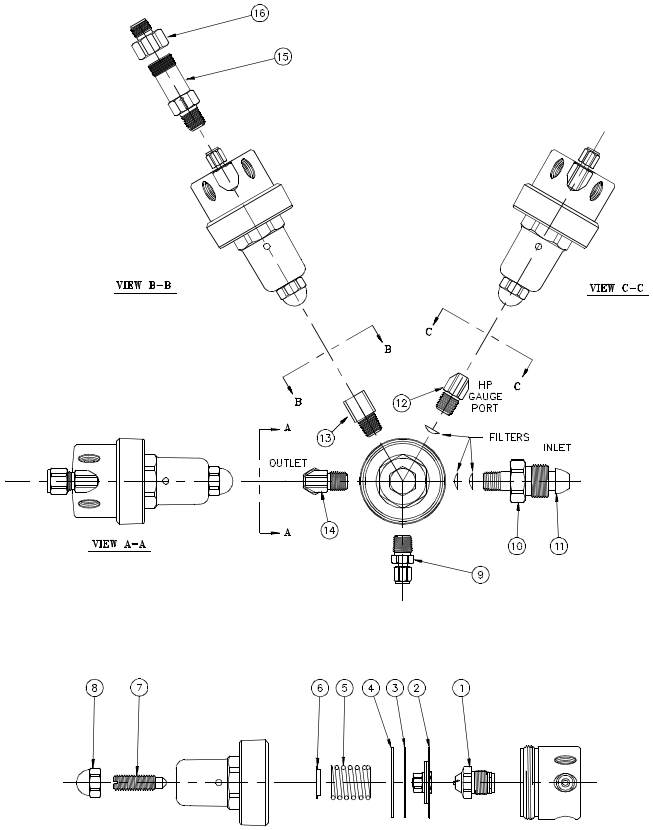
** Item 1 (part no. RO-012E) not included with Manifolds after serial number 20799.

Western Enterprises

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2-9 Series S/N up to 11348

Repair Drawing

Primary Regulator Components



KEY #	DESCRIPTION	PART #	KEY #	DESCRIPTION	PART #
1*	Cartridge Assembly	RWD-2-19	9	1/8" Tube x 1/4 NPT Male	WLF-3-8
2*	Diaphragm Assembly	RWS-3-26	10	Inlet Nut	92
3*	Slip Ring	RWS-3-17	11	Inlet Nipple	15-8
4	Washer	RWS-3-28	12	1/8" Tube x 1/4 NPT 90°	WLF-3-7
5	Bonnet Spring	RWS-1-12	13	1/4 NPT Elbow M x F	BL-4-4LP
6	Pivot	RWC-2-8P	14	3/8" Tube x 1/4 NPT 90°	WLF-3-6
7	Adjusting Screw	RWS-3-3	15	Safety Relief Valve	8533
8	Acorn Nut	RWS-3-1	16	Relief Valve Adaptor	8131

* Item included in repair kits

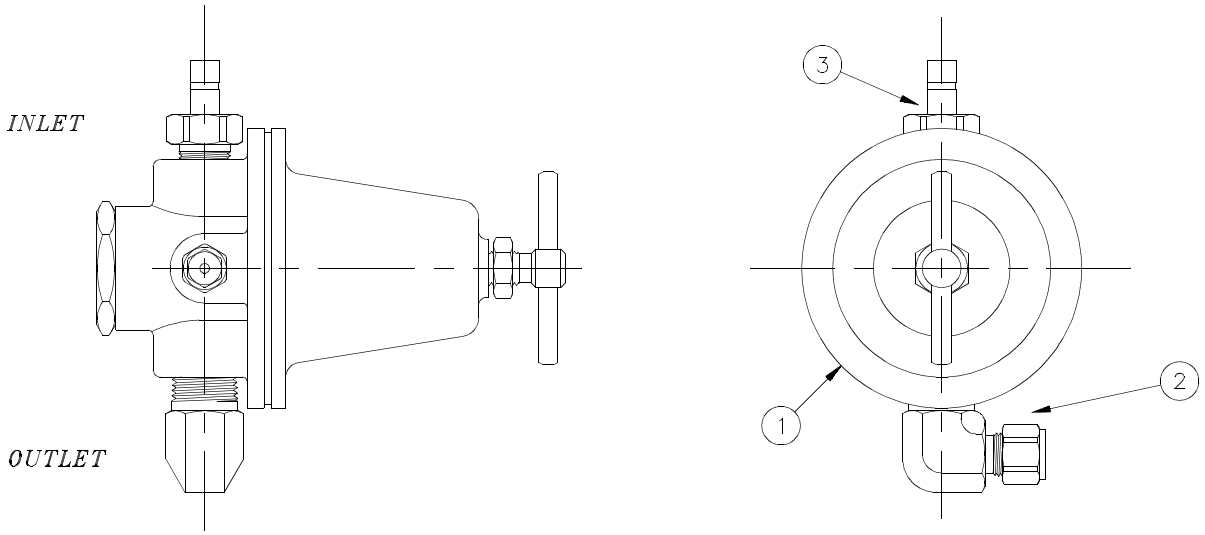
Repair Kit
for HQ2-9 Series RK-1023

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2, HQ2HL & HQ2HP Series

Right Line Regulator Components



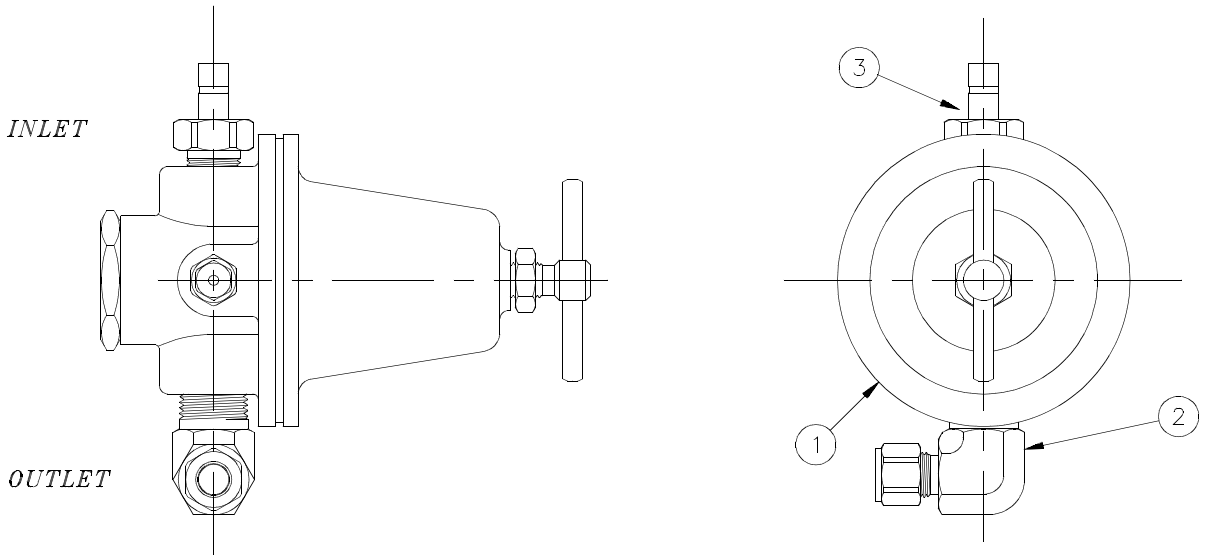
KEY #	DESCRIPTION	PART #
1	Line Regulator	
	for HQ2HP Series	8430
	for HQ2 & HQ2HL Series	8431
2	3/8" Tube x 1/2 NPT Elbow	WLF-3-19
3	3/8" Tube End x 1/2 NPT Adapter	WLF-3-12
	Repair Kit for Line Regulator Internal Parts (Components not shown)	RK-1100

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2, HQ2HL & HQ2HP Series

Left Line Regulator Components



KEY #	DESCRIPTION	PART #
1	Line Regulator	
	for HQ2HP Series	8430
	for HQ2 & HQ2HL Series	8431
2	3/8" Tube x 1/2 NPT Elbow	WLF-3-19
3	3/8" Tube End x 1/2 NPT Adapter	WLF-3-12
	Repair Kit for Line Regulator Internal Parts (Components not shown)	RK-1100

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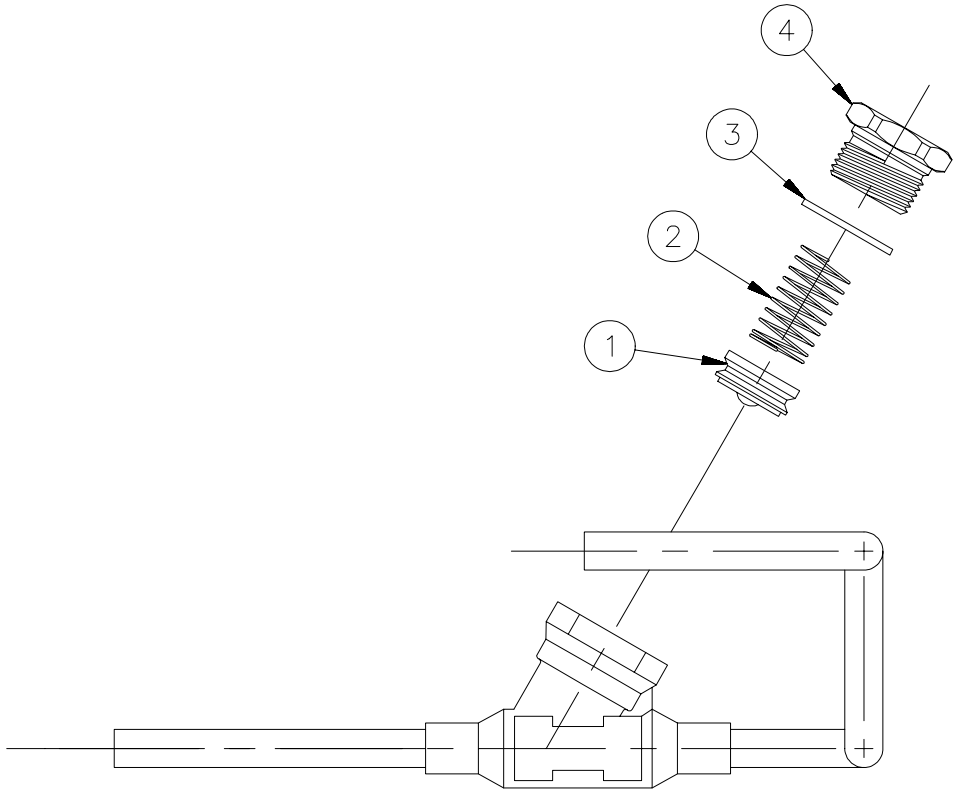
INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2 Series

Repair Drawing

Check Valve Components



KEY #	DESCRIPTION	PART #
1*	Poppet	WMV-1-5
2*	Spring	WMV-1-6
3*	Washer	WMV-1-7
4	Cap	WMV-1-8

* Item included in repair kit

Repair Kit for HQ2, HQ2HL, & HQ2HP Series RK-1041

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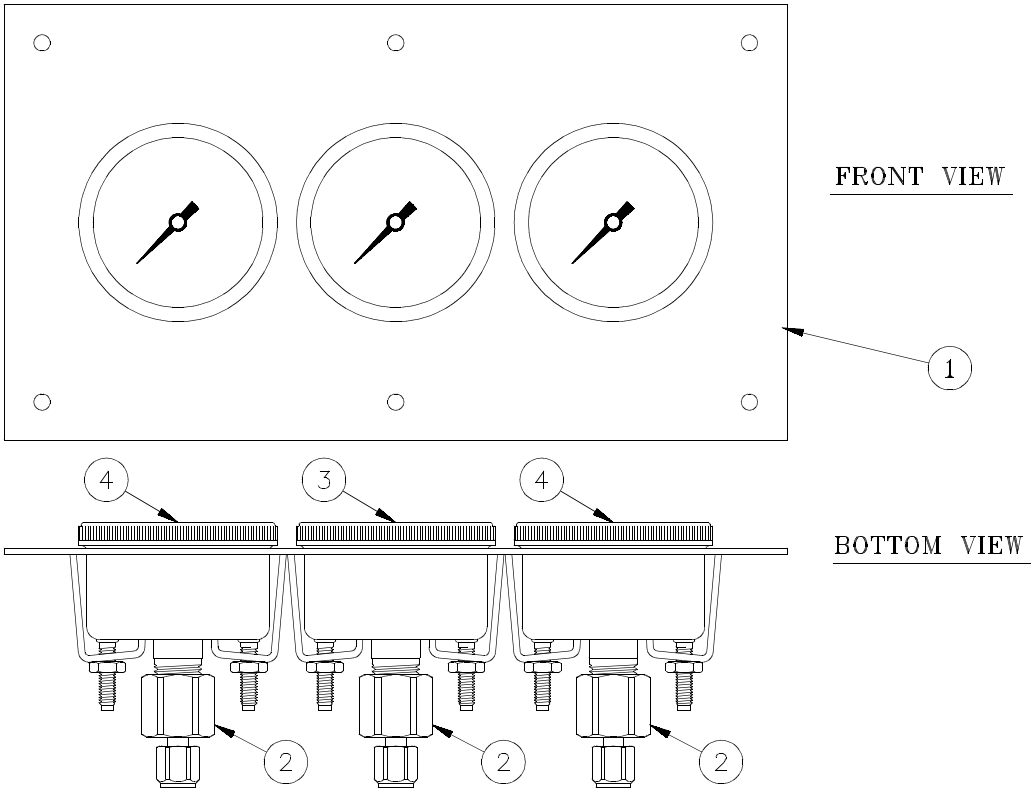
INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2 Series

Repair Drawing

Gauge Plate Components

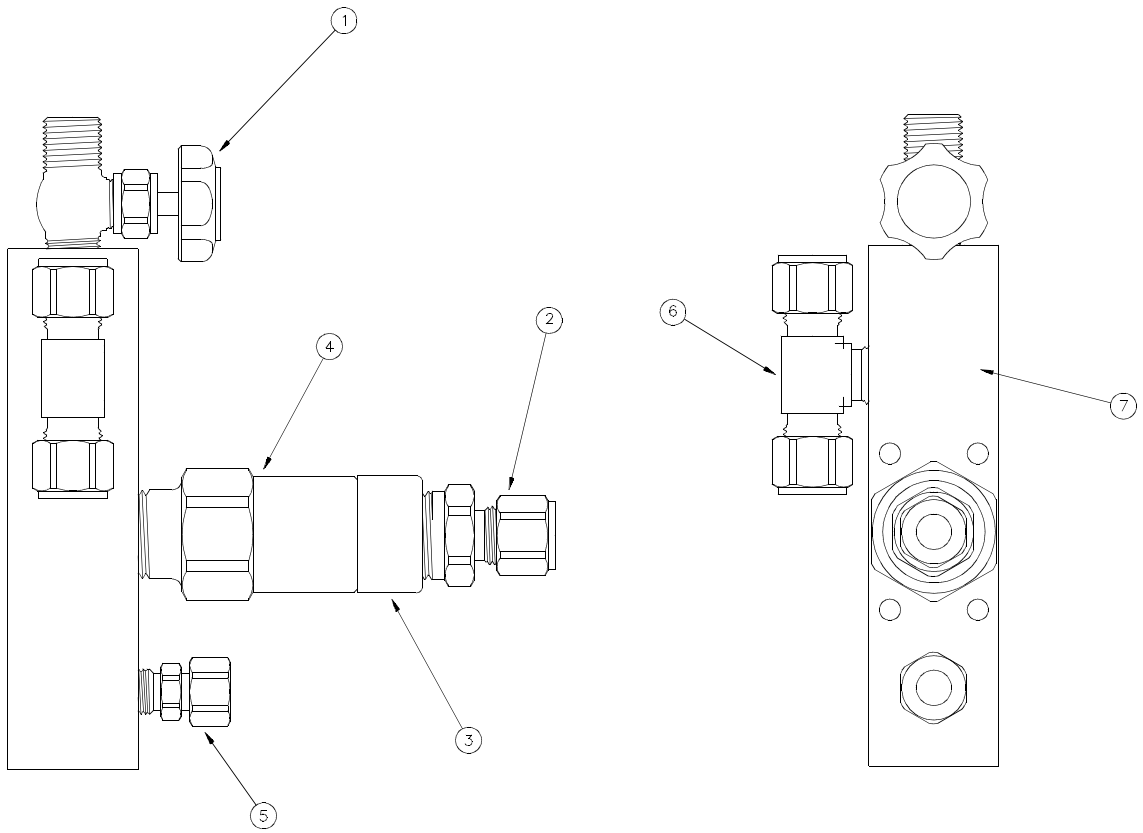


KEY #	DESCRIPTION	PART #
1	5" x 9" Plate	8155
2	1/8" Tube x 1/4 NPT Female	WLF-3-4
3	Line Pressure Gauge	
	for HQ2 & HQ2HL Series, 100 psi	WMG-3-3
	for HQ2HP Series, 400 psi	WMG-3-4
4	Cylinder Contents Gauge	
	for HQ2 & HQ2HP Series, 4000 psi	WMG-3-12
	for HQ2HL Series, 2000 psi	WMG-3-8

Western Enterprises

Repair Drawing

INNOVATOR
AUTOMATIC CHANGEOVER MANIFOLD
HQ2, HQ2HL, & HQ2HP Series
Power Supply Components
(Without CSA Certification)



KEY #	DESCRIPTION	PART #
1	B Size Valve	205
2	3/8" Tube x 1/2 NPT Male	WLF-3-15
3	Pipe Away Adaptor	WMV-8-7
4	3/16" Dia. x 1/4" Rivet	WMC-6-16
	Relief Valve	
	HQ2, HQ2-9 and HQ2HL Series	WMV-8-75
	HQ2HP Series	WMC-8-250
5	1/8" Tube x 1/8 NPT Male	WLF-3-11
6	3/8" Tube x 1/4 NPT Tee	WLF-3-18
7	Outlet Block	WMC-2-26